POWER

A McGRAW-HILL PUBLICATION DEVOTED TO GENERATION, TRANSMISSION AND APPLICATION OF ALL THE POWER SERVICES

JANUARY 1948

IN THIS ISSUE: How a Canadian distillery installed a new boiler plant on the site of an old one without interrupting process service, secured added capacity, cut steam cost, p 66; a down-to-earth discussion of sleeve-bearing fundamentals for the diesel engineer, p 84; practical pointers on maintenance of steam turbines, p 88. Also, the first bow of a new group of reader-service departments: Power Engineering Notebook, p 110; Problems From the Plant, p 11[illegible] Technical Briefs, p 128. **TABLE OF CONTENTS, p [illegible]**

New Micromax A-C Voltage Recorder differs from earlier model because it can be remotely located; differs from all other voltage recorders except Speedomax in that it can be multiple-point. Instrument at top right is in Mission Road Station, City Public Service Board, San Antonio.

R v. 92' Jan.-Apr. 1948

Closer Voltage Regulation Possible With Help of New A-C Voltage Recorders

Suppressed range Recorders, which provide high legibility at the voltage control point, are now available for recording almost any a-c voltage. These Recorders ignore that portion of the voltage range in which the operator is not interested and spread a few volts or kilovolts at the top of the range across a 9.8 inch chart. The instrument can be either Micromax or Speedomax, depending on the speed of fluctuation in the measured voltage.

nt is located at the metering point, there loss in accuracy when the Recorder is e point of voltage detection. A pair of conductors connect the remote metering

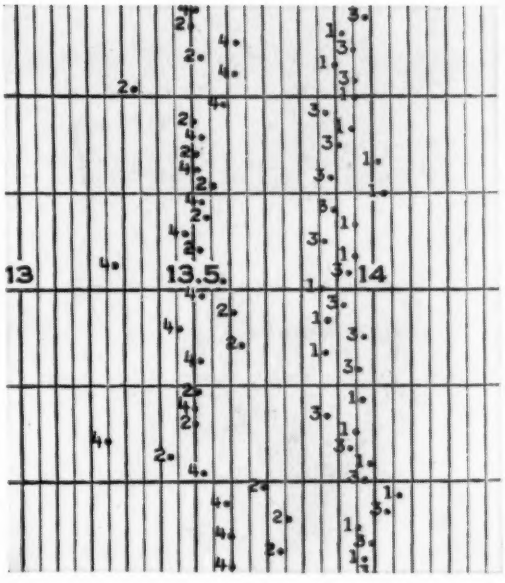
single-point or multiple-point. The lable only from us, offers two outstand-

does the work of as many as sixteen ects a distinct economy.

ecords are quick and accurate; involve from several instruments.

rder which can be more useful in your ontact an L&N engineer.

) Stenton Ave., Philadelphia 44, Pa.



Actual-size portion of a 4-point Speedomax record showing voltages in the vicinity of 13.8 kv. Full range of instrument is 9 to 15 kv.

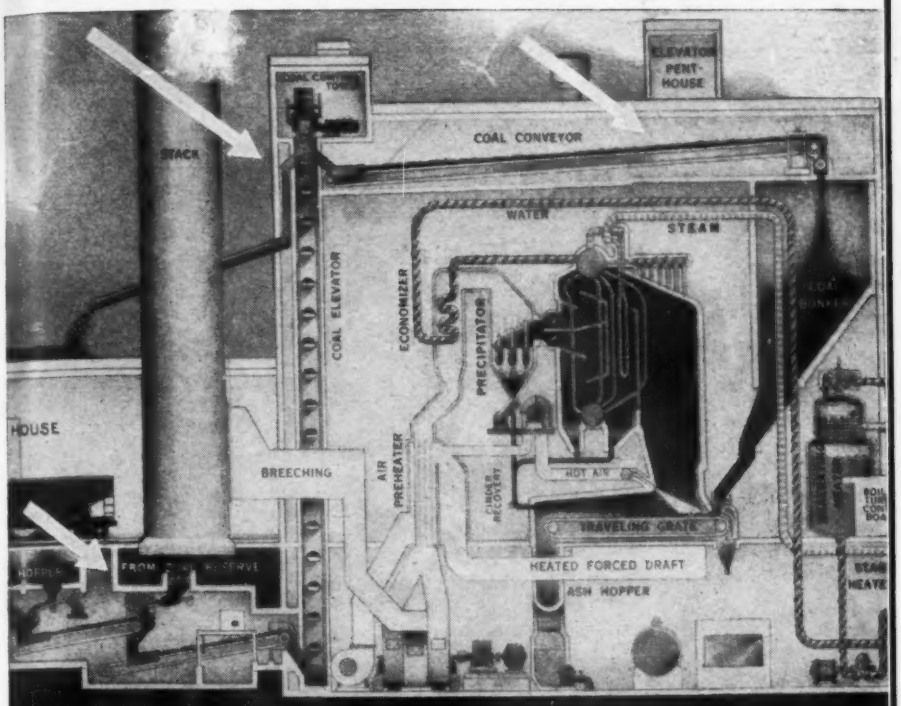
Tech.

STRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

DS & NORTHRUP CO.

'Science and Industry," "The Engineer Review," "The Engineer" and "The Stationary Engineer"), January, 1948, n additional Directory number in December. McGraw-Hill Publishing Company, Inc. Publication office, 99-129 North executive offices, 330 West 42nd Street, New York 18, N. Y. Entered as second class matter August 25, 1936, at), 1879. Printed in U. S. A. Allow at least ten days for change of address. All communications about subscriptions Circulation, Power, 330 West 42nd Street, New York 18, N. Y. Subscription rates—U. S. and U. S. Possessions r copy. Canada $6 for one year, $9 for two years. Pan American Countries, $10 for one year, $16 for two years. A or two years. Please indicate position and company connection on all subscription orders.

CUTTING COSTS WITH CONVEYORS •



Conveyor-elevator system solves unusual problem at central station

● Here's the perfect "doubles" team for power plant materials handling: Link-Belt experience in designing thousands of handling systems for highest efficiency . . . and Link-Belt standard-unit equipment for low first cost and minimum maintenance.

At the Jennison steam-electric generating station of the New York State Electric & Gas Corp., Bainbridge, N. Y. (Gilbert Associates, Inc., Consulting Engineers), the problem was that of handling an abrasive type of coal (No. 4 washed buckwheat anthracite) automatically from R. R. cars to overhead bunkers or reserve, or from reserve to bunkers—at 100 tons per hour.

As shown in illustration above, the integrated Link-Belt handling equipment consists of: 4 reciprocating feeders under track hopper openings, delivering to No. 1 belt conveyor. No. 2 belt conveyor receives coal from No. 1 belt conveyor or reserve storage. A vertical bucket elevator with two-way chute discharges to storage or to No. 3 belt conveyor, as needed. The No. 3 unit discharges to a screw conveyor that takes the coal to the bunkers.

Would you like to have more details on this and other installations? Get in touch with our nearest office.

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Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

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Meets Every Need of Industry On Handling Materials

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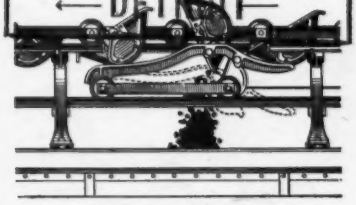
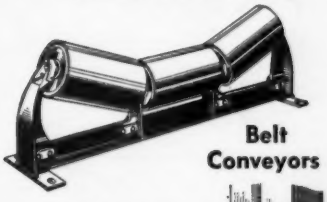
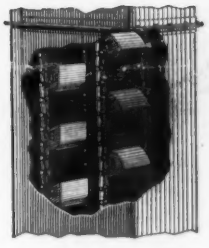


Bucket Carriers



Belt Conveyors

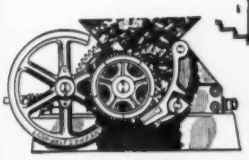


Bucket Elevators

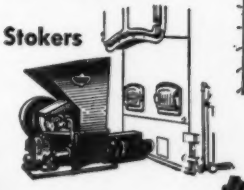
Bulk-Flo

Screw Conveyor

Skip Hoist



Coal Crusher



Stokers

Car Dumper

Weigh Larry

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COAL AND ASHES HANDLING EQUIPMENT

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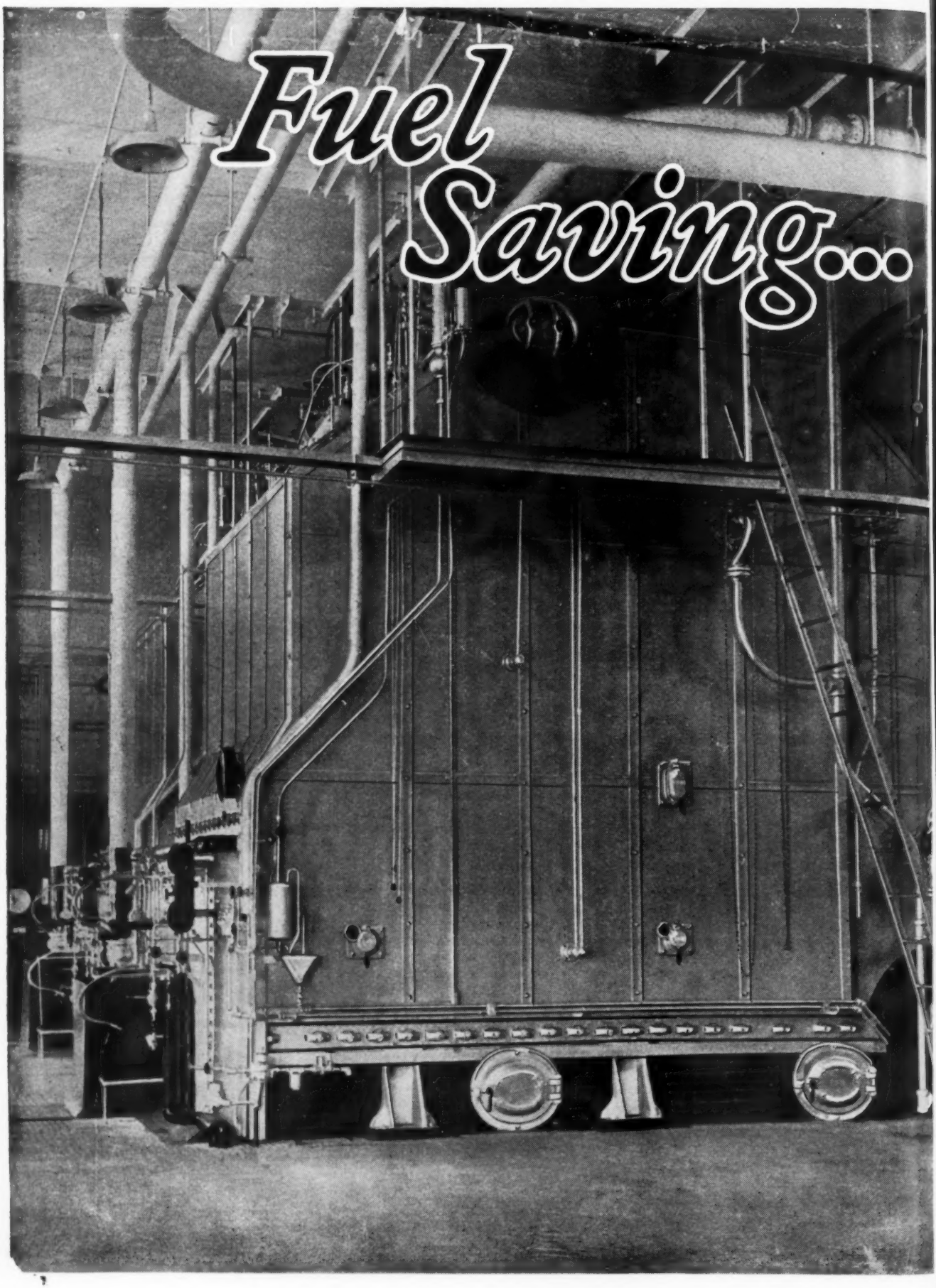
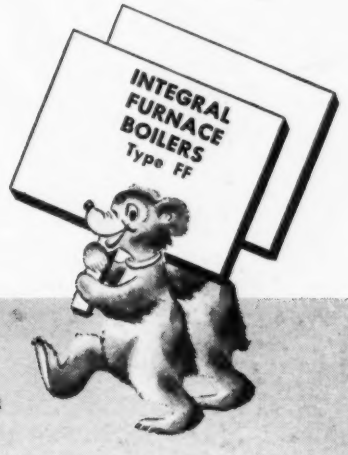


This installation of B&W CUBS* consists of two oil-fired Type FF Integral-Furnace Boilers. Steam Capacity of each is 35,000 lbs. per hr. at 160 psi, 350 F.

25%

with B&W "CUBS"*



How boiler plant modernization is helping to offset rising fuel costs is typically illustrated by the recent experience at a southern asbestos products plant. When *two* new B&W CUBS* replaced *six* old hrt units, a fuel saving of 20 to 25 per cent was immediately realized, along with substantially higher steam generating capacity.

Plant expansion shortly after the CUBS* went into service greatly increased steam demands. "We would have been unable to take care of the situation with the old units", reports the Company. "As it was, the new boilers ran away with the load. All in all, we are very much pleased with their performance, and feel that they are *one of the best investments we ever made*".

Any industrial plant requiring boilers of 10,000 to 50,000 lb. per hr. steam capacity can have the cost-saving benefits that are "wrapped up" in all B&W CUBS*. Three *different types* are available, each having distinctive features that make it the best choice for a wide variety of operating conditions. A B&W engineer will be glad to explain fully why they are such a good buy.

*Complete Unit BoilerS

Each as much a package boiler as any unit of its capacity can be.

G-357T

FOR POWER PLANTS — B&W, Open-Pass, Radiant, Integral-Furnace, Cross-Drum, Stirling and Waste-Heat Stationary Boilers . . . Air Heaters . . . Economizers . . . Superheaters . . . Water-Cooled Furnaces . . . Oil, Gas & Multi-fuel Burners . . . Chain-Grate Stokers . . . Stacks and Breechings . . . Seamless & Welded Tubes . . . Refractories . . . Chemical Recovery Units . . . Alloy Castings.

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OTHER B&W PRODUCTS — Marine Boilers . . . Pressure Vessels . . . Process Equipment.

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GENERAL OFFICES: 85 LIBERTY ST., NEW YORK 6, N.Y.
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That new, big modern Elliott motor—makes

FABRI-STEEL

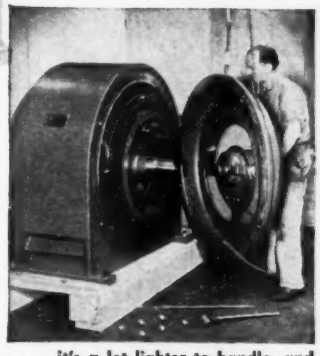
Elliott

estake-downs quick and simple!

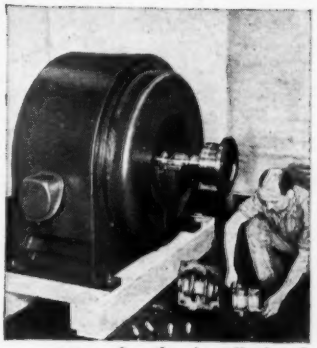
How to pull out a rotor

NO NEED FOR SPLIT BRACKETS OR MOVING THE MOTOR. On the free end of the motor (opposite the driven element) remove the bearing bracket cap screws, hook in the hoist, and start sliding complete bracket, with bearing assembled, off the rotor shaft.

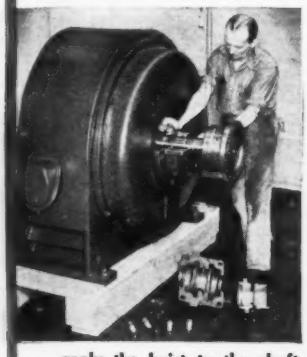
That solid bracket, like the motor frame, is of steel, and a good 30% lighter than a cast iron bracket of similar size. So . . .



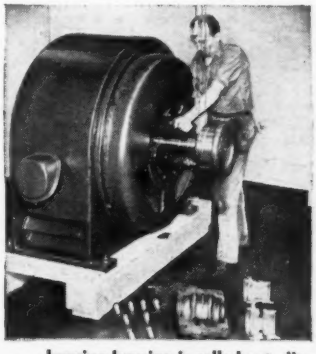
. . . it's a lot lighter to handle, and can be easily swung off and out of the way, leaving that end of the motor entirely open. That end of the rotor is then supported by the stator core. Next . . .



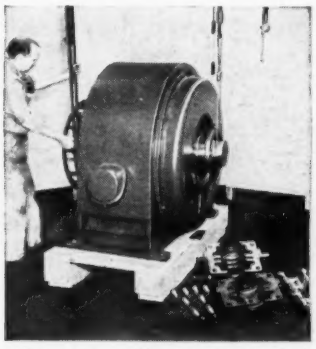
. . . start on the other (coupling) end of the motor, disconnect the coupling, take out the four cap screws and bolts holding the bearing cap, and also the top half of the split sleeve bearing. Then . . .



. . . apply the hoist to the shaft, lifting it a trifle to take the weight off the lower half of the bearing. Roll the lower half around to the top of the shaft, lift it off, remove the cap screws holding the bottom bearing housing. Then . . .



. . . bearing housing is rolled out, disclosing an opening in bracket large enough, in most cases, to permit coupling half to pass through without removing it from rotor. You don't have to touch the bearing bracket on this side. Saves a lot of trouble.



Then place a sling on the exposed shaft on the end of the motor from which bracket was removed. Push back outer part of coupling and place another sling. Give slings a bit of lift, and the rotor will then swing free. Start pulling it out. Next . . .

. . . transfer sling on coupling shaft after moving shaft enough to insert screw eyes for the hoist hooks, in the tapped holes usually provided in the coupling for pulling off coupling half. This permits of further withdrawal of the rotor. Finally . . .

. . . transfer the rope sling to the center of the rotor, so that it balances in the sling. Swing the rotor out still farther, unhook the sling from the coupling end of the shaft . . .

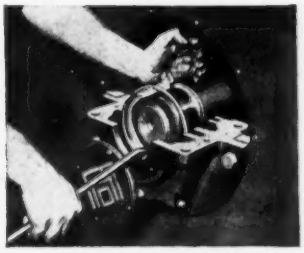
. . . pull the rotor clear out. That's all there is to it — and you've done the job without shifting the motor or taking off the coupling — hitting a new low in motor maintenance.

To reverse the steps above except in replacing front bearing bracket assembly, rotate bracket 180 degrees to hold oil ring so it will clear shaft — push on and rotate bracket back to correct position.

Fabri-steel motors are built in 150 to 1000 hp, four to fourteen poles, drip-proof, splash-proof, forced-ventilated, pipe or base ventilated. Write for bulletin.

How to replace a bearing

Remove two cap screws, two bolts and two dowels and lift off the bearing cap. Pull out two small dowels and take off the upper half of the split sleeve bearing. Then . . .



. . . with a pry bar under the boss on the shaft end, raise the shaft enough to take the weight off the lower half of the bearing, roll it round to the top of the shaft and take it out from under the oil ring. An easy job.

L-782

COMPANY *Electric Power Dept., RIDGWAY, PA.*

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Diamond Soot Blowers

TO SUIT YOUR INDIVIDUAL NEEDS

AIR CLEANING

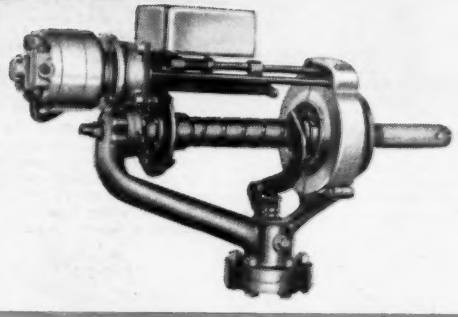
TYPE OF OPERATION	TYPE OF CONTROL
AIR ELECTRIC MANUAL	AIR ELECTRIC AIR-ELECTRIC MANUAL

STEAM CLEANING

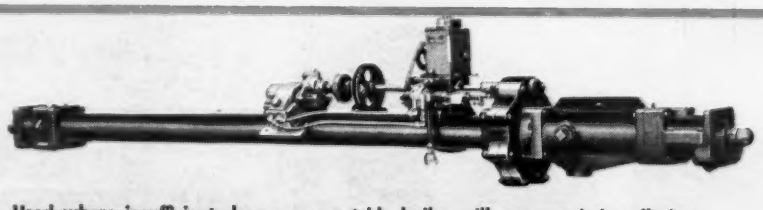
TYPE OF OPERATION	TYPE OF CONTROL
AIR ELECTRIC MANUAL	AIR ELECTRIC AIR-ELECTRIC MANUAL

DIAMOND
MODEL IR
Short Retracting Soot Blower

For cleaning furnace walls or boiler heating surfaces where gas temperatures exceed limit for permanently installed units. Equally applicable to compressed air or steam as a cleaning medium. Manual, air, or electric operation. Advantages include: positive poppet type valve, 12" travel, no lubrication, simple construction, exceptional durability, etc.

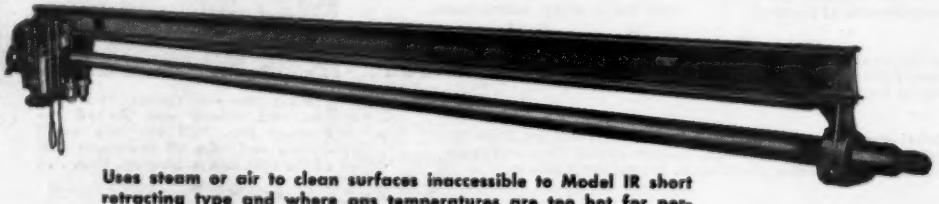


DIAMOND
TELESCOPIC
Long Retracting Soot Blower



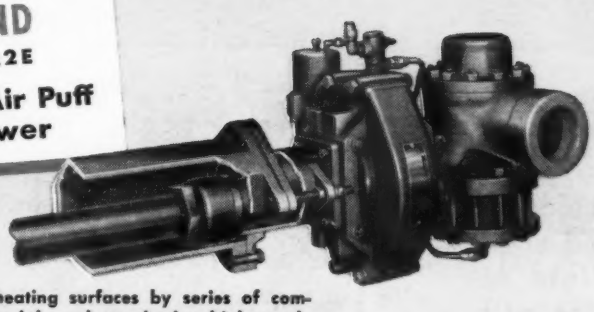
Used where insufficient clear space outside boiler will not permit installation of Model IK retracting blower for cleaning surfaces inaccessible to short retracting blower and where gas temperatures are too hot for permanently installed units. Uses air or steam as cleaning medium. Either electric or air operation.

DIAMOND
MODEL IK
Long Retracting Soot Blower



Uses steam or air to clean surfaces inaccessible to Model IR short retracting type and where gas temperatures are too hot for permanently installed soot blowers. Three standard sizes have travels of 10', 12' and 16'; also special travels up to 20'. Either air or electric operation.

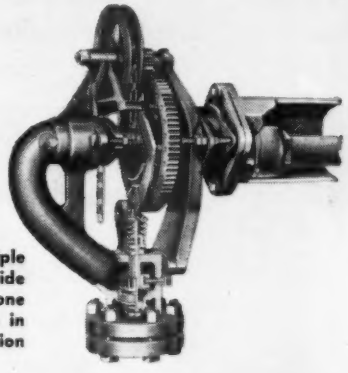
DIAMOND
MODEL A2E
Automatic Air Puff Soot Blower



Automatically cleans heating surfaces by series of compressed air puffs delivered through standard multiple nozzle blowing element. Spreading cleaning cycle over longer time permits smaller compressor and receiver . . . also eliminates stack discharge nuisance.

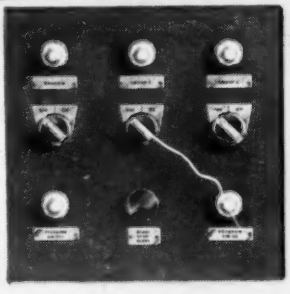
Master Controller automatically controls blowing time and sequence. Just a "twist of the wrist" to open valve . . . controller does rest. Automatic control assures correct boiler cleaning and no labor is needed.

DIAMOND
MODEL G9B
Soot Blower



Uses steam as cleaning medium through multiple nozzle blowing element permanently installed inside setting. "Automatic Valved" requiring only one continuous operation to open and close valve in head and simultaneously rotate element. Operation is manual, air or electric.

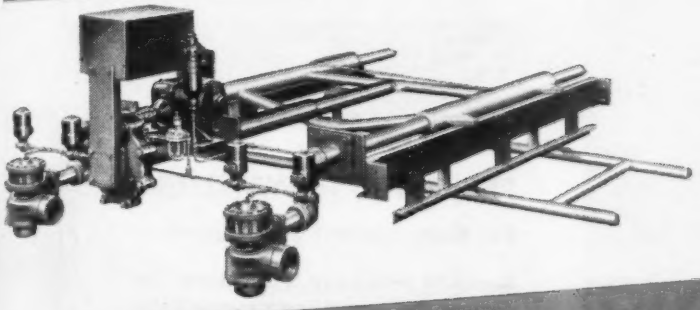
DIAMOND
ELECTRIC
Control Panel



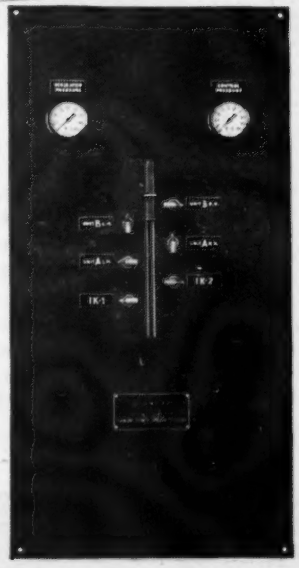
For controlling any combination and number of blowers. All are operated in correct sequence and at right blowing speed by pushing one "start" button.

DIAMOND
AUTOMATIC
Air Heater Blower

One or more multiple nozzle blower elements supported on frame which traverses in straight line across tube sheet. Blowing medium is compressed air discharged intermittently to limit compressor and tank size. Air or electric operation—air or electric control, completely automatic.



DIAMOND
AIR
Control Panel



Can be arranged for controlling any number of blowers or groups of blowers. Correct cleaning is always assured and labor is saved.

Operating conditions and individual preferences vary so greatly that there is need for wide choice in soot blower types and soot blowing methods.

Diamond offers the greatest choice in both methods and blowers—from simple manually operated steam or air cleaning to Diamond Automatic Sequential Blowing which cleans the boiler completely at the turn of a switch. There is a Diamond combination to do a better cleaning job on any type boiler.

DIAMOND POWER SPECIALTY CORP.

DETROIT 31, MICHIGAN

Diamond Specialty Limited • Windsor, Ontario

BOILER CONTROLS • INSTRUMENTS • PROCESS CONTROLS

The Republic Flow Meters Co. offers a complete manufacturing and engineering service in the field of measurement and control. We will be glad to co-operate with you in the solution of any metering or control problem, whether it involves a single instrument or the automatic control of an entire process or plant.

Republic engineers, in co-operation with your own engineers, will be glad to study your problem and make recommendations as to the most practical solution. Your inquiries will involve no obligation on your part.

BOILER CONTROLS

For All Types of Boilers

Republic offers a centralized, automatic system for controlling steam pressure, combustion, furnace pressure, excess pressure, boiler water level, etc.

Automatically regulates the fuel and air imput to a boiler in measured proportions and in a fixed ratio for the entire load range. Available for all sizes of boilers and all types of fuel firing.

FLOW METERS

Electrical and Mechanical

Republic electrical type remote reading flow meters are available for measuring the flow of all types of liquids and gases. Meter bodies are built for line pressures up to 10,000 p. s. i. and for all ranges of differential pressures.

Mechanical ring-balance meters are built for static pressures up to 2500 p.s.i. and to operate on differentials as low as 3 in. of water.

BOILER METERS

Record Steam Flow—Air Flow

The Republic boiler meter records simultaneously on one chart the steam flow from the boiler and the rate of air flow to the furnace for combustion.

The air flow pen is adjusted to record coincident with the steam flow pen when the furnace is receiving the proper amount of air for maximum combustion efficiency.

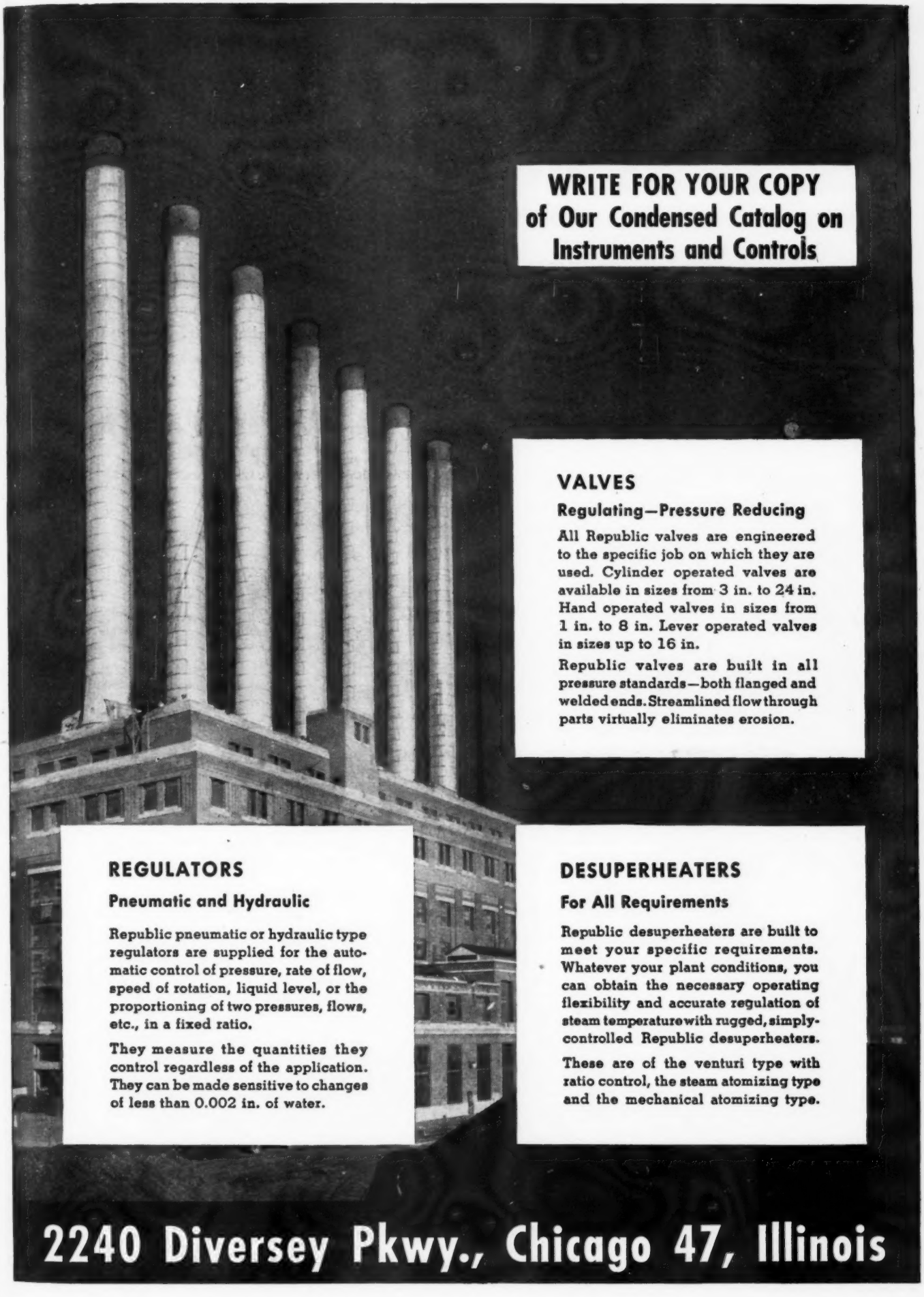
PNEUMATIC TRANSMITTERS

For Measurement and Control

Republic pneumatic transmitters are devices for converting process variables, such as flow, liquid level, pressure or liquid density, into air pressures which vary proportionally with the process variables.

These air pressures can be used as the measuring impulse for the actuation of an automatic controller or a direct reading recorder.

REPUBLIC FLOW METERS CO.



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VALVES

Regulating—Pressure Reducing

All Republic valves are engineered to the specific job on which they are used. Cylinder operated valves are available in sizes from 3 in. to 24 in. Hand operated valves in sizes from 1 in. to 8 in. Lever operated valves in sizes up to 16 in.

Republic valves are built in all pressure standards—both flanged and welded ends. Streamlined flow through parts virtually eliminates erosion.

REGULATORS

Pneumatic and Hydraulic

Republic pneumatic or hydraulic type regulators are supplied for the automatic control of pressure, rate of flow, speed of rotation, liquid level, or the proportioning of two pressures, flows, etc., in a fixed ratio.

They measure the quantities they control regardless of the application. They can be made sensitive to changes of less than 0.002 in. of water.

DESUPERHEATERS

For All Requirements

Republic desuperheaters are built to meet your specific requirements. Whatever your plant conditions, you can obtain the necessary operating flexibility and accurate regulation of steam temperature with rugged, simply-controlled Republic desuperheaters.

These are of the venturi type with ratio control, the steam atomizing type and the mechanical atomizing type.

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SUN "JOB PROVED" PRODUCTS CUT COSTS, SPEED PRODUCTION, IMPROVE QUALITY

Proof of the value of any industrial product lies in the experience that practical men have had with it. Sun products have been "Job Proved" in the lubrication of almost every type of mining, manufacturing, power and transportation equipment . . . in refrigeration and air-conditioning . . . in metal cutting, tempering and quenching . . . in the processing of textile fibers, leather, natural and synthetic rubbers . . . in the impregnation of electrical, electronic, and packaging materials of various kinds.

To help you find solutions to problems in any of these fields, Sun Oil Company offers a wide selection of "Job Proved" petroleum products, plus the experience of Sun Engineers. Their know-how and detailed product information are yours for the asking, without obligation. Telephone your local Sun office, or write Dept. P-1 . . .

SUN OIL COMPANY
Philadelphia 3, Pa.

"JOB PROVED" PETROLEUM PRODUCTS FOR INDUSTRY

SUN INDUSTRIAL OILS

SOLNUS OILS — Well-refined straight mineral oils. Stand up under hard use for long periods of time. Recommended for use in the machine tool industry, in air compressors, certain types of Diesels, etc.

SUNVIS OILS — Are in the same category as Solnus Oils with the difference that, in addition, they meet practically all paraffinic and high V.I. oil specifications.

OCNUS OILS — Low carbon-content oils, containing an additive which minimizes oxidation and gives detergency. Ideal lubricants for internal combustion engines subjected to continuous heavy loads under the most adverse operating conditions.

DYNAVIS OILS — Low pour point inhibited oils which help prevent formation of harmful corrosive and sludge-forming acids. Well-suited for engines fitted with alloy bearings and operated at high temperatures.

SUNTAC OILS — 100% petroleum products which have been treated to increase their adhesiveness. Recommended for general lubrication in all industries where sudden shocks and reversal of loads take place. These oils cling to the parts to be lubricated.

CIRCO OILS — Used for general lubrication of industrial machinery when straight mineral oils are required.

SUNISO REFRIGERATION OILS — Have extremely low pour points and long life stability characteristics. Initially neutral and resistant to formation of detrimental acids under service conditions. The most outstanding oils in the refrigerating and air-conditioning fields.

STEAM CYLINDER OILS — High flash and fire point lubricants for either saturated or superheated steam conditions and for worm gear speed reduction units.

SUN CAR JOURNAL OILS — Dark oils meeting A.A.R. Specifications. For use on railroad cars and waste-packed bearings of railroad equipment.

SUN DELAWARE OILS — Dark oils for general lubrication on older type industrial machinery.

SUNOCO WAY LUBRICANT — Has good metal-wetting and adhesive properties, ample viscosity and E.P. qualities. For use on tableways, as it eliminates chatter and scoring . . . resists corrosion.

SUN MARINE ENGINE OILS — Compounded with special emulsifying agents in order to provide adhesion to and lubrication of working parts in the presence of water. For the lubrication of bearings, eccentrics, cross-heads and various other parts of steam engines.

ROCK DRILL OIL — Heavy-duty adhesive type oil. For use in jack-hammers, stopers and drifters on heavy-duty mining operations.

SUNVIS 900 SERIES TURBINE OILS — High V.I., predominantly paraffinic oils, of uniform 0°F. pour points, containing additives to give high oxidation stability and corrosion resistance under practical operating conditions. Modern oils for turbine and hydraulic systems.

SUN INDUSTRIAL GREASES

SUN CUP GREASES — Water resistant. For grease cup and grease gun application when the service is not severe.

SUN GUN GREASES — Smooth greases made with medium viscosity oil. Stable under pressure in power guns or booster guns.

ADHESIVE PRESSURE GREASES — Won't drip or splash and are excellent lubricants for open gear applications.

SUN DARK PRESSURE-SYSTEM GREASES — For power-driven central grease lubricating systems in heavy industries. Can also be used as a "medium cup grease."

SUN MINE CAR GREASES — Available in several grades. Suitable for both anti-friction bearings and plain bearing cavity-type wheels.

SUN ROLLER BEARING GREASES — For use on electric motors and generators and other high-temperature machinery equipped with ball or roller bearings.

SUN GEAR COMPOUNDS — Black adhesive open gear compounds and wire cable greases. Recommended for open gears on metalworking power presses, mining machinery, old reduction mills, crushers, pump gears, etc.

SUN MINING MACHINE LUBRICANT — Semi-fluid. For use where a light but adhesive type grease is required. Free from separation or decomposition.

SUNOCO TRACTOR ROLLER COMPOUND — For miscellaneous parts of caterpillar or crawler-type tracks. Provides good lubrication with exceptional sealing qualities.

SUN METALWORKING OILS

SUNICUT — Straight or non-emulsifiable transparent cutting oils. Recommended for automatic screw machines and for heavy-duty machining operations.

SUN INDUSTRIAL

JOB PROVED

SUNOCO EMULSIFYING CUTTING OIL—A self-emulsifying oil which produces a stable white emulsion when mixed with water. Sunoco is an efficient and economical cooling and lubricating medium for turning, milling, drilling, and other metalworking operations on both ferrous and non-ferrous metals. It is also an excellent grinding coolant.

SUN QUENCHING OILS—Specially refined oils designed to develop maximum physical properties in a wide variety of steels.

SUN TEMPERING OILS—Specially refined oils for tempering steel up to 550°F. Due to their low carbon content and stability under heat, these oils have an unusually long service life.

SUN ROLLING OILS—Straight and emulsifying oils which will permit maximum production in rolling steel, aluminum and brass.

SUN ANTI-RUST COMPOUNDS—Petroleum base oils with chemical additives designed to prevent the rusting and corrosion of steel.

SUN PROCESSING OILS

SUNOTEX TEXTILE OILS—Designed to impart certain additional properties to various forms of fibers during their processing from the fiber state into a manufactured product. All Sunotex textile oils are emulsifiable in water.

SUN COTTON CONDITIONING OILS—Pale mineral oils which condition the cotton. They prevent waste by cutting down excessive amounts of "fly" or fine air-borne particles of lint.

SUN ASBESTOS FIBER CONDITIONING OIL—Used for spraying on the asbestos during processing. Fibers are not so readily damaged or broken down into harmful dust when this product is used.

SUN CORDAGE OILS—Are adaptable in various formulae used by cordage manufacturers. They are selected products which are highly compatible with additives.

CIRCOSOL—2XH (Rubber Processing)—An elasticator and processing aid for GR-S particularly.

CIRCO LIGHT PROCESS OIL (Rubber Processing)—A processing aid and excellent softener for natural rubber, natural rubber reclaims, and neoprene synthetic rubber particularly. Used for GR-S to some extent.

SUNDEX 53 (Rubber Processing)—An inexpensive product suitable for processing GR-S and blends of GR-S and natural rubber. An established outstanding processing aid for footwear rubber stocks.

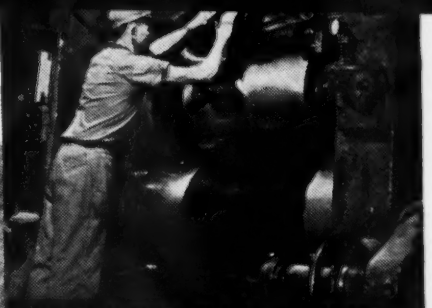
CIRCOMAR-5AA (Rubber Processing)—A black colored product used in reclaiming natural rubber scrap. Used also as substitute for asphalt fluxes in processing natural and GR-S rubber. Free-flowing at room temperature.

SUN LEATHER OILS—Mineral base leather oils. Used for obtaining the desired tensile strength, proper temper and a controlled moisture content. They maintain a light even color . . . mix well . . . distribute evenly.

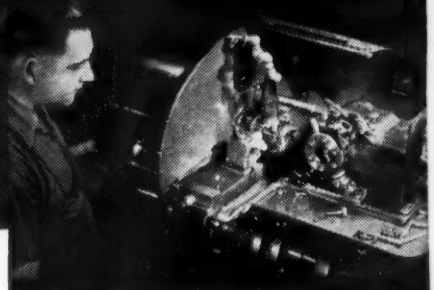
SUN MISCELLANEOUS INDUSTRIAL PRODUCTS

SUN SPIRITS—For the thinning of paints, varnishes, and enamels. Also for metal cleaning. This product is a pure water-white petroleum solvent and is free of corrosive sulphur.

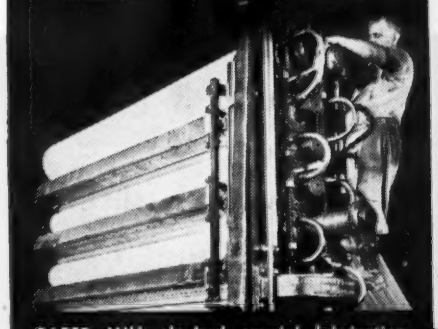
SUN WAXES—Used in packaging, sealing, coating, waterproofing and for numerous manufacturing and chemical processes.



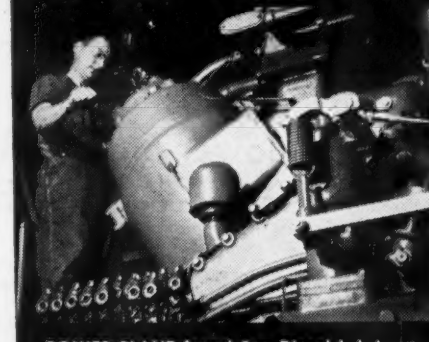
RUBBER MANUFACTURER saved $3,000 a year with a Sun Processing Aid.



ALUMINUM PARTS MANUFACTURER increased output 43% with Sun Cutting Oil.



PAPER MILL slashed annual lubrication bill $2,874 by using a Sun Grease.



POWER PLANT found Sun Diesel Lubricant lasted 50% longer.

A TEXTILE MILL increased slashing speed 60% by adopting a Sun Processing Oil.

PRODUCTS

SUNOCO

How Much Profit Do

$Fuel dollars wasted at the boiler cut your profits. If you are seeking ways to trim costs you may find your boiler room is the place to begin. Make certain you are getting co-ordinated boiler control. This way you can be sure you are getting maximum returns from your fuel dollars.

The Bailey co-ordinated boiler control system prevents wasted fuel. It increases safety of operation, improves continuity of service and reduces maintenance costs. Combustion, feedwater, steam temperature, heater levels, pump speed, and all other factors are co-ordinated to deliver maximum power at minimum cost.

The Bailey co-ordinated boiler control system pays its way in fuel saved because every system is engineered to the specific conditions under which it must operate. Like your power plant, it fits the job. To find out how Bailey controls can improve your boiler performance, we suggest that you—

Call This Man

He is a Bailey engineer. Back of him are years of experience in engineering control systems for fuel burning equipment of all types. He will work directly with you and your engineers in the design and application of the meters and controls required by your installation.

This engineering service is yours for the asking—available in more than 30 industrial areas throughout the United States and Canada.

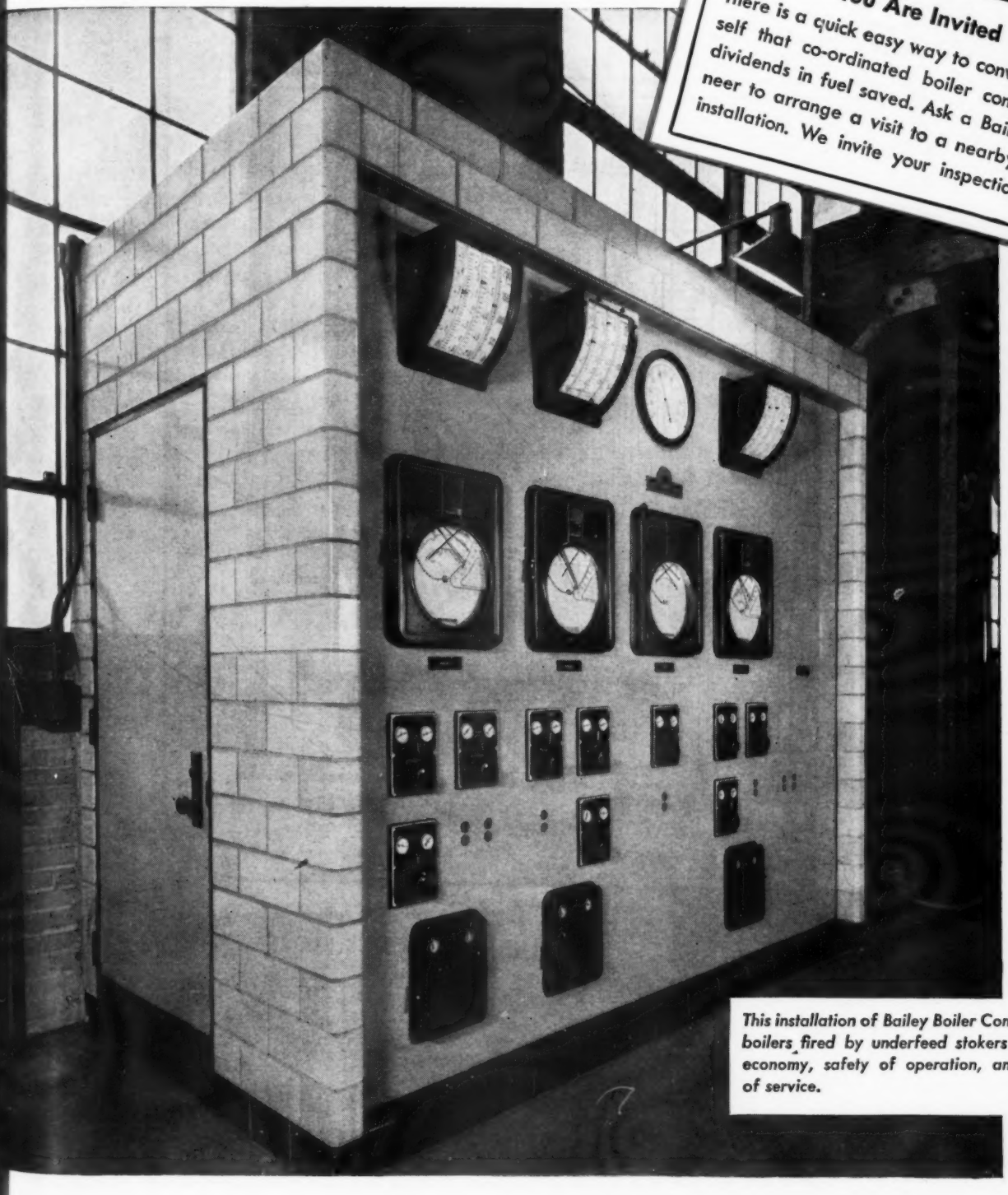
BAILEY METER COMPANY
1036 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls FOR STEAM PLANTS
COMBUSTION • FEEDWATER • TEMPERATURE
PRESSURE • LIQUID LEVEL • FEED PUMPS

You BURN At Your BOILER?

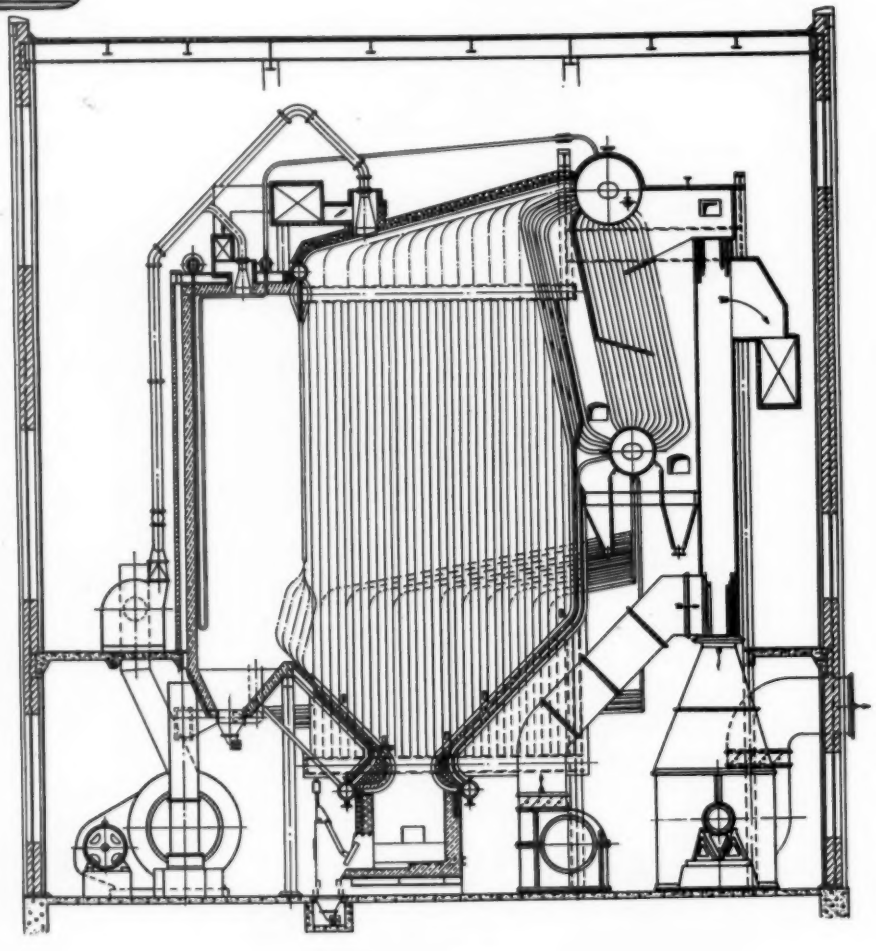
You Are Invited

There is a quick easy way to convince yourself that co-ordinated boiler control pays dividends in fuel saved. Ask a Bailey engineer to arrange a visit to a nearby Bailey installation. We invite your inspection.



This installation of Bailey Boiler Control on three boilers fired by underfeed stokers insures fuel economy, safety of operation, and continuity of service.

KVS ... steam ...



KVS Products

Boilers	Economizers	Coal-Weighing Scales
Fans	Water Walls	
Air Preheaters	Coal Elevators	Ash Conveyors
Superheaters	Bunkers	

Air Swept Tube Mill Pulverizers

GENERATORS

Completely engineered to assure Economy, High Efficiency and Low Maintenance

Modern features of this complete, pulverized coal-fired steam-generating unit have been engineered by KVS to achieve over-all high efficiency on a wide range of coals and to assure close temperature control under practically all load conditions.

Accurate control of superheat and total steam temperature is provided by locating the superheater in a separate furnace fired by an individual burner. Varying heat output of this burner places in the operator's hands effective means of regulating steam temperature at any steam flow. Automatic regulation of fuel and air to burner makes possible the maintenance of uniform steam temperature over any range of load and under any load variation.

Proper coal pulverization for the combustion requirements involved in this design is assured through the use of the Kennedy Air-Swept Tube Mill Pulverizer which provides a continuous, dependable supply of superfine pulverized coal regardless of the quality of coal available, and at lowest cost per ton of coal handled.

Units of this type can be furnished for any capacities, pressures or temperatures and high efficiency can be obtained with either bituminous or anthracite coals.

KVS ENGINEERING KVS Steam Generating Equipment has been performance proved over the years. KVS offers a complete service in design, building and erecting complete plants under one responsibility. KVS engineers are available for consultation on your requirements.

KVS ENGINEERING SERVICE

BULLETIN NO. 44B

Ask for a copy of 97-page Engineering Bulletin No. 44-B containing valuable information on preparation of pulverized fuel and steam generating plants.

KENNEDY-VAN SAUN · QUALITY · SERVICE · Kennedy Products · NEW YORK · USA · MFG. & ENG. CORP.

Kennedy-Van Saun

MANUFACTURING AND ENGINEERING CORPORATION

2 PARK AVENUE • NEW YORK 16, N. Y.

FACTORIES: DANVILLE, PA.

CANADA • ENGLAND • FRANCE • AUSTRALIA

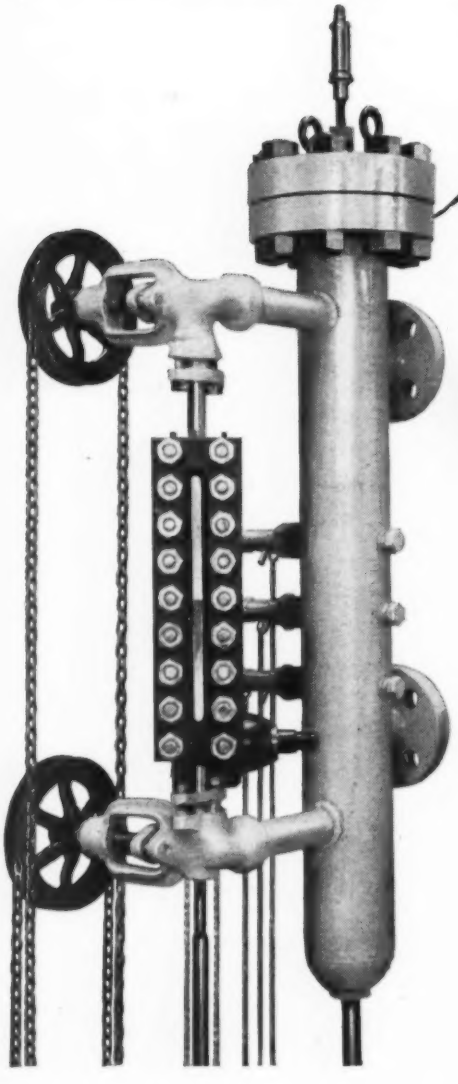
DETROIT PUBLIC LIBRARY

Yarway Hi-Lo Alarm Water Column with Flat Glass Gage

Alarm mechanism uses balanced solid weights and operates on the displacement principle to give instant, positive warning of dangerous changes from normal water level. Flat glass pressure-sealed gage insert is mica protected and has spring cushion which prevents excessive strain on glass. Types for pressures to 1500 psi. See Bulletin WG-1810.

Yarway Remote Boiler Water Level Indicator

Brings hard-to-see overhead gage readings down to eye level, on instrument panel or any other convenient location. Always accurate because it's operated by the boiler water itself. Indicating mechanism is never under pressure. *There are no stuffing boxes.* Action is instant, constant and practically frictionless. Moderate in cost... easy to install. See Bulletin WG-1821.



More and more plants today are insisting on Yarway 3-way boiler trim — columns and gages, remote boiler water level indicators and blow-off valves. It's sound practice, too, because it adds up to *good boiler protection.*

Yarway blow-off valves are standard equipment in more than 12,000 boiler plants today . . . and plant engineers are obtaining the same dependable, trouble-free service from other Yarway boiler trim, shown above.

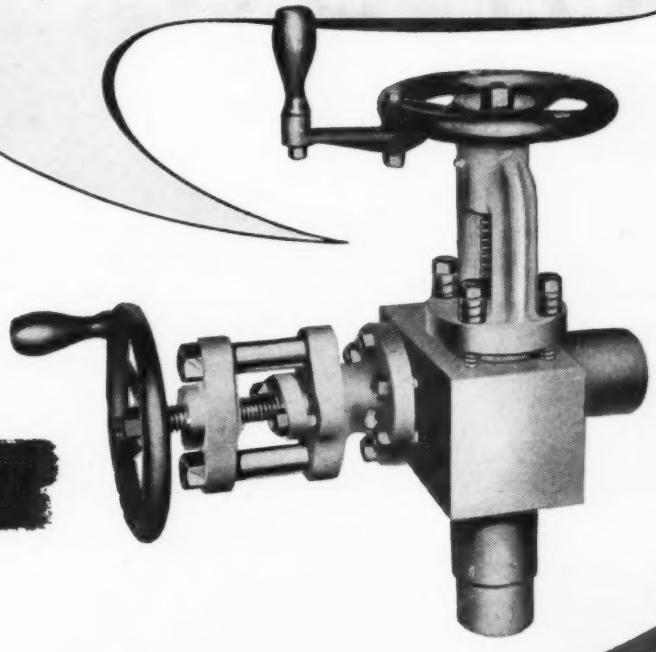
Boilers are costly investments. Protect them with Yarway Boiler Trim.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY

Yarway Unit Tandem Blow-Off Valves

For pressures to 2500 psi. Used for blowing or for draining and sealing. Combines the famous Yarway balanced sliding plunger Seatless Valve and a specially-designed Hard-Seat Valve in a single one-piece forged steel body. See Bulletin B-432. For other Yarway Blow-Off Valves suitable to lower pressures, see Bulletin B-424.



GOOD BOILER PROTECTION

STEAM PLANT EQUIPMENT

now!

a simple a-c with 3 to 1 speed

TRI CLAD
REG. U.S. PAT. OFF.

Type ACA adjustable-speed induction motor

GENERAL ELECTRIC

750-292

motor range

HERE'S WHERE TO USE IT!

Textile
Slashers
Knitting machines
Individual finishing machines
Spinning frames
Printing machines

Chemical
Shakers
Grinders
Pulverizers
Mixers
Liquid pumps
Solids pumps

Metal-Working
Drawbenches
Lathes
Stamping presses
Milling machines
Grinders

Printing
Job presses
Coating machines
Trimming machines
Stitching machines
Rotary web presses

Food
Ovens
Proofers
Mixers
Fillers
Labelers
Grinders
Centrifugals
Conveyors
Shaker Screens
Pumps
Blanchers

Paper
Winders
Slitters
Supercalenders
Coating machines
Waxing machines
Embossers
Other converting machinery
Stock preparation machinery
Conveyors

Non-Ferrous & Rock Products
Mill feeder drives
Crusher feeder drives
Sinter conveyors
Other conveyors

Yes – you can now get a simple a-c motor and stepless speed adjustment over a 3 to 1 range *in a single, compact enclosure!* At the twist of a dial, the new Tri-Clad Type ACA induction motor changes speed quickly and accurately without *any power converting equipment.* Practically no different looking than any other induction motor, the Type ACA is a simple, economical way to equip old and new machines with an adjustable-speed drive and still retain the advantages of a-c motor operation.

Constant torque at any speed!

This new Tri-Clad motor provides constant torque over the entire 3 to 1 speed range and *holds* its speed despite load changes. Its efficiency and power factor are high at any speed – an important advantage where long operation over most of the speed range is customary. And for EXTRA PROTECTION against physical damage, electrical breakdown, and operating wear and tear, it features sturdy Tri-Clad design and construction.

Up to 50 hp available!

The Tri-Clad Type ACA induction motor with 3 to 1 speed adjustment is now available in ratings from 3 to 50 hp. Standard NEMA dimensions are used. For remote control, a flexible cable or pilot motor are available. Write today for Bulletin GEA-4883. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

You can't beat Tri-Clad Extra Protection!

GENERAL ELECTRIC COMPANY, Section A750-292
Apparatus Department, Schenectady 5, N. Y.

Please send me Bulletin GEA-4883 which describes the new Tri-Clad Type ACA motor:

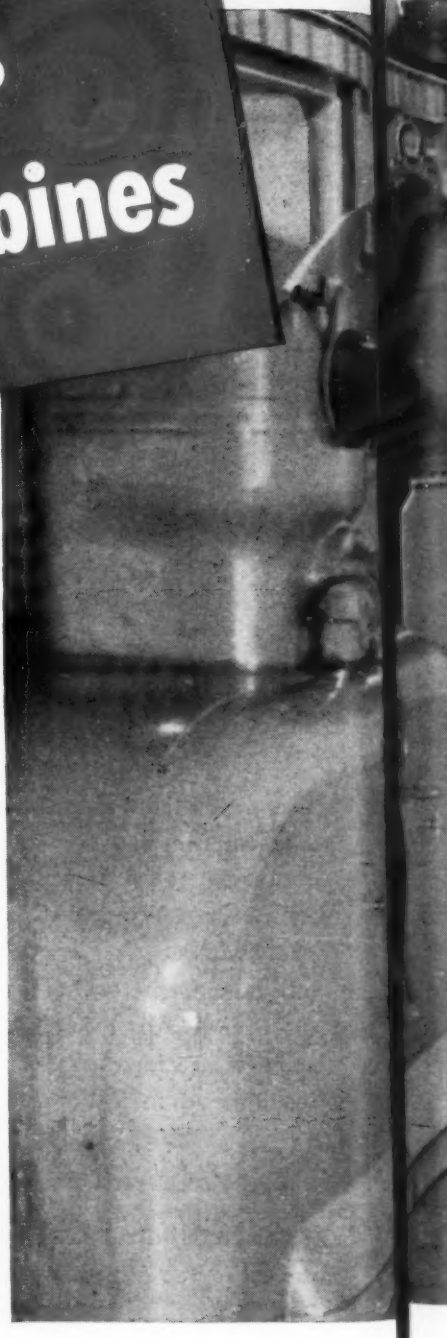
NAME_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

Utility company's own record puts Nonpareil in 18 turbines



A large midwest utility company, operating wide-spread plants, installed Nonpareil Turbine Oil in some of the turbines at two stations. Operating records were kept of all oils used in the company's turbines. Samples of the oils were tested periodically by the Chief Chemist. A study of the records over a period of years revealed that in the turbines lubricated with Nonpareil:

. . . the neutralization number remained at a constant low level.

. . . there was no down time for cleaning the oil system or for changing oil.

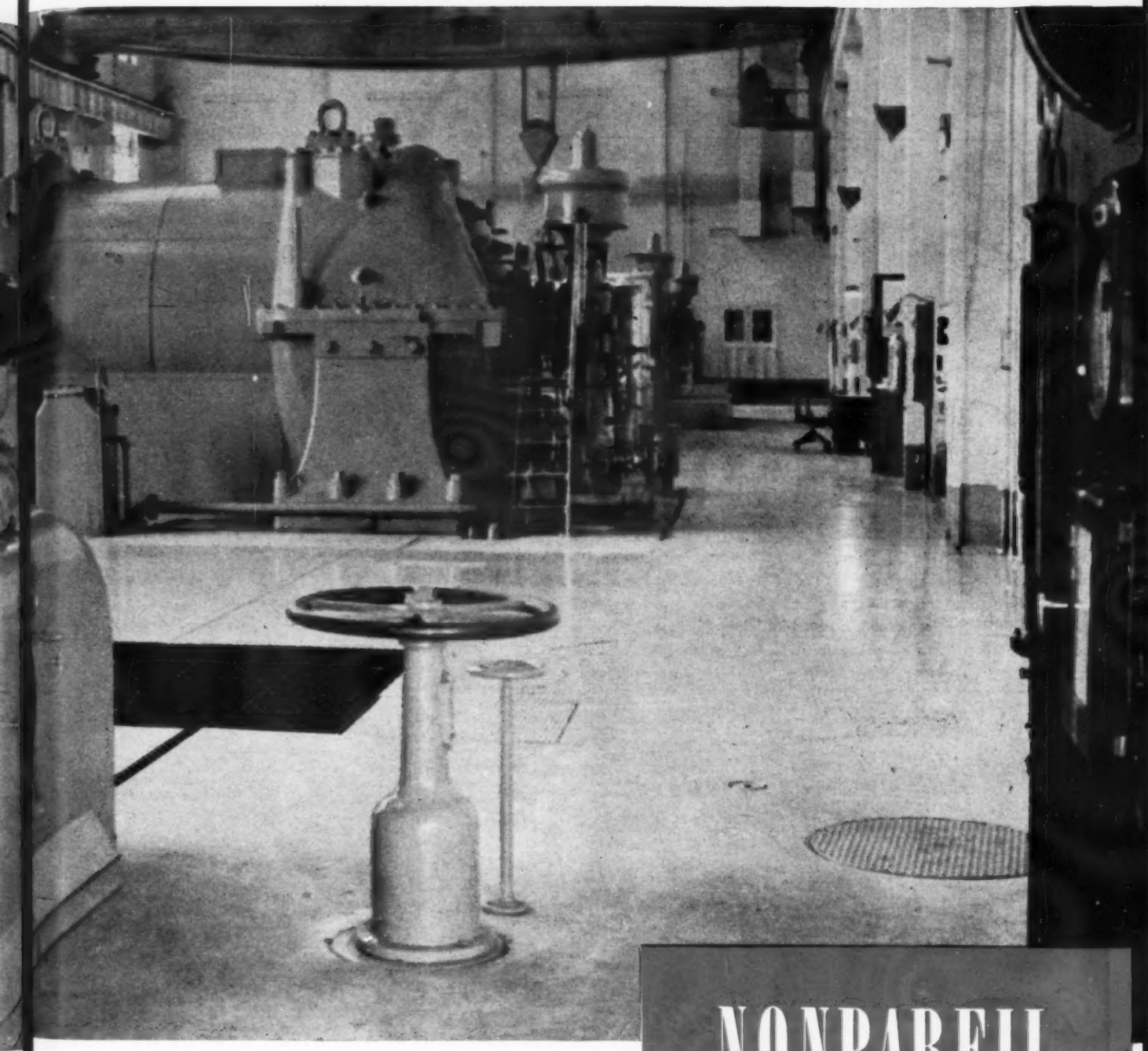
. . . the over-all cost of operation was lower, while the earning power was greater because turbines were on the line longer.

Naturally, the decision was to switch to Nonpareil for all units. To date, 18 turbines with a total capacity of 211,000 KW are lubricated with Nonpareil.

Ask a Standard Oil Lubrication Engineer about nearby power plants where you can check for yourself the record Nonpareil is making. Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA)

STANDARD SERVICE



NONPAREIL

TURBINE OIL

STANDARD OIL COMPANY (INDIANA)

STANDARD SERVICE

Don't buy any DOZER the revolutionary

The Tournadozer is correctly designed for efficiency in any type pushing as well as dozing. Increasing load on blade puts more weight onto Tournadozer's giant rubber tires giving more traction for greater pushing power. Maneuverability and instantaneous gear selection means easier contact with pushed equipment . . . less waiting time.

Big 21.00 x 25 rubber tires on the Tournadozer provide plenty of flotation and traction . , . eliminate multiple moving parts constantly operating in grinding dirt. Tapered bead tire and rim design prevent tire slippage . . . permit lowering tire pressures for extra flotation to meet extreme conditions in sand or mud, ice or snow.

Finger touch selection is instantaneous for any one of four gear combinations that drive the Tournadozer . . . 1.91 to 15 m.p.h. both forward or reverse. Constant mesh Tournamatic transmission with air-actuated controls eliminates conventional gear shifting, simplifies operation.

Air actuated controls throughout, low pressure shock-absorbing tires, good visibility and a special hydraulic suspension seat reduce operator fatigue. He's happier because he drives a faster, snappier, easier riding rig . . . gets more work done . . . no end-of-day letdown.

LE TOURNEAU

LET

See your Le Tourneau Distributor NOW for complete information

until you've seen NEW TOURNADOZER

THE NEW high-speed, rubber-tired Tournadozer is built for both dozing and pushing . . . ideal for stockpiling coal, leveling waste dumps, stripping, conveyor and hopper loading, clearing and leveling new building sites, building and maintaining roads . . . also for push-loading big scrapers. Travels two to three times faster than crawler-tractor. No delay in shifting gears with Tournamatic constant-mesh transmission. Quick on-the-job or job-to-job moves . . . no hauling equipment needed . . . travels on pavement, black-top, or cross country. Gets more jobs done with fewer men and machines. Wait till you see this Tournadozer in action before buying new dozer equipment!

Tournadozer, Tournamatic — Trademark R113 I

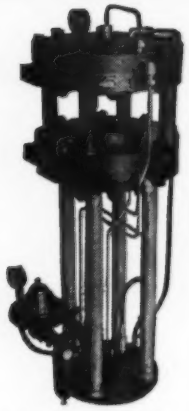
Model C

- **Speeds up to 15 m.p.h., forward and REVERSE**
  4-speed selections from 1.91 m.p.h.
- **Non-stop, instantaneous speed selection**
  Constant-mesh Tournamatic transmission.
- **Easy to operate . . . air actuated controls**
  Finger-tip steering and blade operation . . . single pedal for brakes.
- **Tapered bead tires . . . 21.00x25**
  Permit lower pressure for operation in sand or muck.
- **Big load capacity . . . 11' 2"x43" blade**
  Lift 44", drop, unlimited; cable control; fast-acting.
- **180 h.p. Diesel . . . weight 15 ½ tons.**

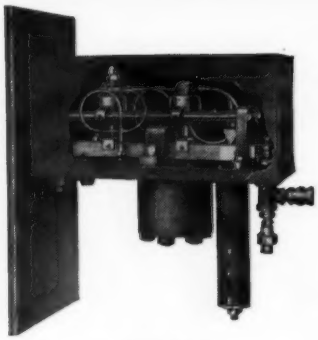
LETOURNEAU
PEORIA, ILLINOIS

HIGH-SPEED RUBBER-TIRED TOURNADOZERS

STEAM SEPARATOR



HAGAN THRUSTORQ



TYPE "F"
MASTER SENDER

RATIO RELAY

RING BALANCE
FLOW METER
(Indicating, Integrating
& Recording)

RING BALANCE
FLOW METER
(Integrating & Recording)

Typical applications for

This partial list, and accompanying photographs are published to remind you that Hagan service is broader than the automatic combustion control systems which are usually associated with the Hagan name.

Control of combustion rate of boilers

Constant or graduated draft control

Constant or graduated pressure control

Feeder or stoker speed control

Control of multiple fuel firing

Fan speed control

Pump speed control

Hydraulic coupling control from speed or delivery of driven unit

Constant differential pressure control (liquids or gases)

Accurate control of position from remote point

Control of steam, gas, and liquid pressures

Measurement of steam, gas and liquid pressures

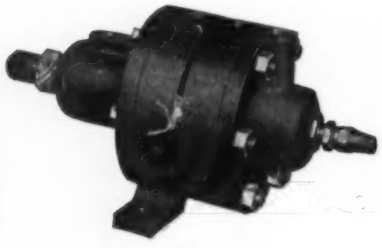
Control of pump discharge pressure and flow

Steam flow control

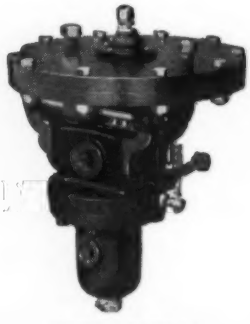
Steam pressure reduction and desuperheating control

Steam temperature control (superheat)

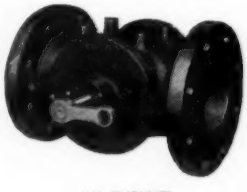
Removal of oil, moisture and solids from exhaust steam



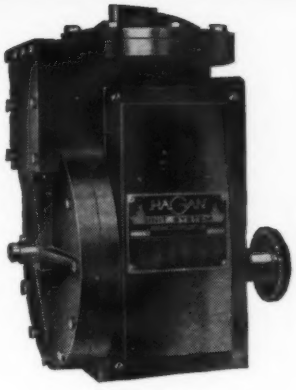
TYPE "F"
TOTALIZER



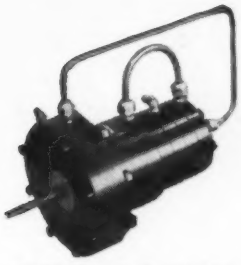
DIFFERENTIAL
TRANSFORMER



V PORT
BUTTERFLY
VALVE

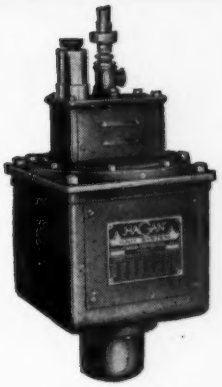


VARIABLE
RATIO REGULATOR



MICRO-POSITIONER

RECEIVING
REGULATOR



DIAPHRAGM
REGULATOR

HAGAN *equipment*

Removal of oil and moisture from compressed air

Control of separately fired superheaters

Flow control (liquids and gases)

Flow measurement of liquids and gases with pressure and temperature compensation

Gas mixing control

Fuel-air ratio control

High temperature regulation

Remote manual or automatic control

Recovery of steam from continuous blowdown systems

Program control

Oil burner control

By-pass damper control for air preheaters

Feed water heater pressure and temperature control

Liquid level control

Control of multi-speed motor drives

Safety protection for gas or pulverized coal firing

Steam jet refrigeration control

Force measurement and control

Measurement and control of thrust and torque

We will be glad to supply full information concerning any of these applications or pieces of equipment.

Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

THERMOSTAT

HAGAN
HALL
BUROMIN
CALGON

HAGAN CORPORATION

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

Avoid Needless Losses

Due to Motor Burnouts

Protect Small Motors

As Well As Large Ones

with BUSS

Here's Proof That It Pays To Protect Small Motors

What is the FUSETRON?

The Fusetron is a DUAL element device — a Fuse to which is added a Thermal cutout.

The result is a fuse with tremendous time-lag and much less electrical resistance.

Fusetrons have the same degree of Underwriters' Laboratory approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses, Fusetrons fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere in both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

"In May, 1944, our progress in filling a contract for white uniforms was being seriously interfered with by motor burnouts and fuse blows on our power sewing machines. Each of these machines is driven by a half h. p. three phase 220 volt 2.3 ampere motor. Ordinary one-time fuses were then used. When the correct size fuse was used, it frequently blew when operators started their machines under load with the clutch out. Single phasing frequently resulted and then the motor was usually burned out before the fuse could be replaced. Our master mechanic was spending so much time replacing fuses that he began to use the maximum size he could get in the holder, 30 ampere, which, of course, resulted in still more burned out motors.

"About that time the President and General Manager of our company, wrote for information on Fusetrons. 2½ ampere Fusetrons were recommended. We had them installed at once.

"In July, 1945, our Superintendent reported that not one motor had been lost since Fusetrons were installed — and that the saving in man hours formerly wasted while burned out motors or fuses were replaced had helped us to fill our orders on schedule."

(A large southern manufacturer—name on request)

Fusetrons Prevent Shutdowns—Save Costs

The cost of installing Fusetrons is mighty small compared to the losses incurred when a motor burns out. You have not only the cost of removing and replacing the burned-out motor, but the cost of the shutdown as well.

It will pay you to guard against these double losses by installing Fusetrons on small motor circuits such as pumps, fans, blowers, compressors, conveyors, mixers, grinders, stokers, oil burners — and hundreds of others.

FUSETRONS

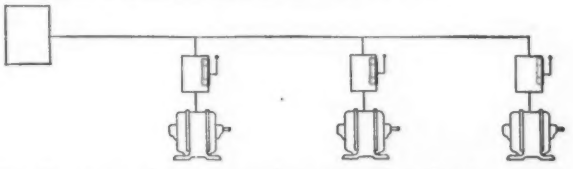
Simple to Install

Just install a Fusetron of motor-running protection size anywhere in the circuit to handle only the motor current. Then on all normal installations, the motor will be protected against burnout due to lack of oil, worn bearings, tight belt, overloading — or anything that causes a dangerous excess of current through the motor.

If the motor is on a separate circuit,

a Fusetron of proper size in the switch or panelboard protects the motor and the circuit wiring.

If the motor is on a circuit feeding several motors,



install a Fusetron of motor-running protection size to protect each motor.

That's how simple it is to protect your motors from burnout — and yourself from losses due to motor burnout.

Fusetrons Give Many Other Kinds of Protection Heretofore Not Available

Fusetrons do everything fuses do, as is confirmed by Underwriters' Laboratories Label, and in addition . . .

✱ Entirely wipe out needless blows caused by motor starting currents or other harmless overloads. ✱ Give Thermal Protection to Panelboards and Switches. ✱ Lesser resistance means cooler operation and prevents needless blows caused by heating in panels and switches. ✱ Permit use of larger motor or adding more motors on circuit WITHOUT installing larger switch or panel. ✱ On new installations, PROPER size switches and panels can be used instead of OVERSIZE. ✱ Protect small motors against burnout simply and inexpensively. ✱ Give DOUBLE protection to large motors. ✱ Provide simplest way to stop burnouts from single phasing. ✱ Protect coils, transformers and solenoids against burnout.

Get All the Facts—Get Better Protection—Send the Coupon Now!

Even one lost motor, or one needless shutdown or one destroyed panel may cost you far more than replacing every fuse with a FUSETRON.

Don't risk such losses — protect yourself by changing over the fuses in your entire electrical system to FUSETRONS.

BUSSMANN MFG. COMPANY
University at Jefferson, St. Louis 7, Mo.
(Division McGraw Electric Company)

BUSS FUSETRONS—SOLD THROUGH WHOLESALERS

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me complete facts about BUSS Fusetrons.

Name _____

Title _____

Company _____

Address _____

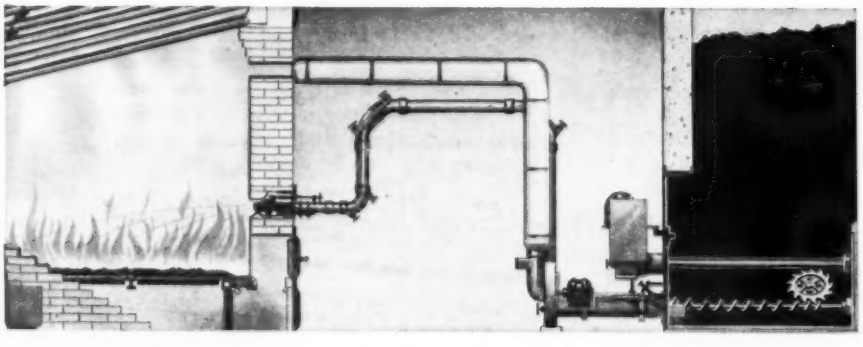
City _____ *State* _____ 148

5 Advantages

Here's Why Pneumatic Spreader Stokers

GET RESULTS...

ADVANTAGES	RESULTS
1 PNEUMATIC COAL FEED: Coal is dried and preheated, then conveyed pneumatically to the furnace, where it is distributed evenly over patented grates. Preheated coal ignites and burns faster when it enters the furnace. Fines burn more completely and less unburned carbon is carried over with products of combustion.	No manual coal handling. Reduced cinder carryover. Higher combustion efficiencies. Extremely responsive to load changes.
2 SHALLOW, UNIFORM FUEL BED: Adjustable nozzle spreads coal evenly over special grate in a shallow layer. Fines burn in suspension. Shallow fuel bed permits use of low-pressure undergrate air and small fan motors. Small amount of fuel in furnace produces greater responsiveness to load fluctuations.	Quick pick-up. Steady steam pressure. Low fan operating cost. Minimum banking loss. Easier fire cleaning.
3 BALANCED FUEL-AIR RATIO: Iron Fireman's *exclusive* Air Volumeter automatically maintains correct fuel-air ratio *essential* to peak efficiency combustion, regardless of fuel bed density or type of coal burned. This self-regulating air Volumeter permits the successful and efficient burning of low-cost coals.	Efficient firing cuts coal consumption. Use of low-cost coal gives additional fuel savings.
4 ADAPTABILITY: Pneumatic coal-conveying system, using overhead pipes, is easily installed in any boiler-room. Coal pick-up unit can be located anywhere within a radius of 50 feet or more of boiler front, at the side, or even behind the boiler; in another room or on a different floor level.	Low labor costs through automatic coal handling. No need for costly boiler-room alterations or elaborate conveyor systems and overhead bunkers. Clear boiler fronts and firing aisles.
5 DEPENDABILITY: Easy-to-reach mechanism can be quickly inspected. No moving parts are exposed to direct furnace temperatures.	Continuous, troublefree operation. Freedom from costly shutdowns. Low maintenance costs.



IRON FIREMAN PNEUMATIC SPREADER STOKER. Steam size coal is metered from hopper or main coal bunker and transferred by pneumatic conveyor to furnace. Conveyor nozzle accurately spreads larger particles of coal over entire grate in a shallow, uniform fuel bed. Preheated fines burn in suspension, reducing cinder carryover and greatly improving combustion efficiency and responsiveness, as compared with stokers which do not preheat coal.

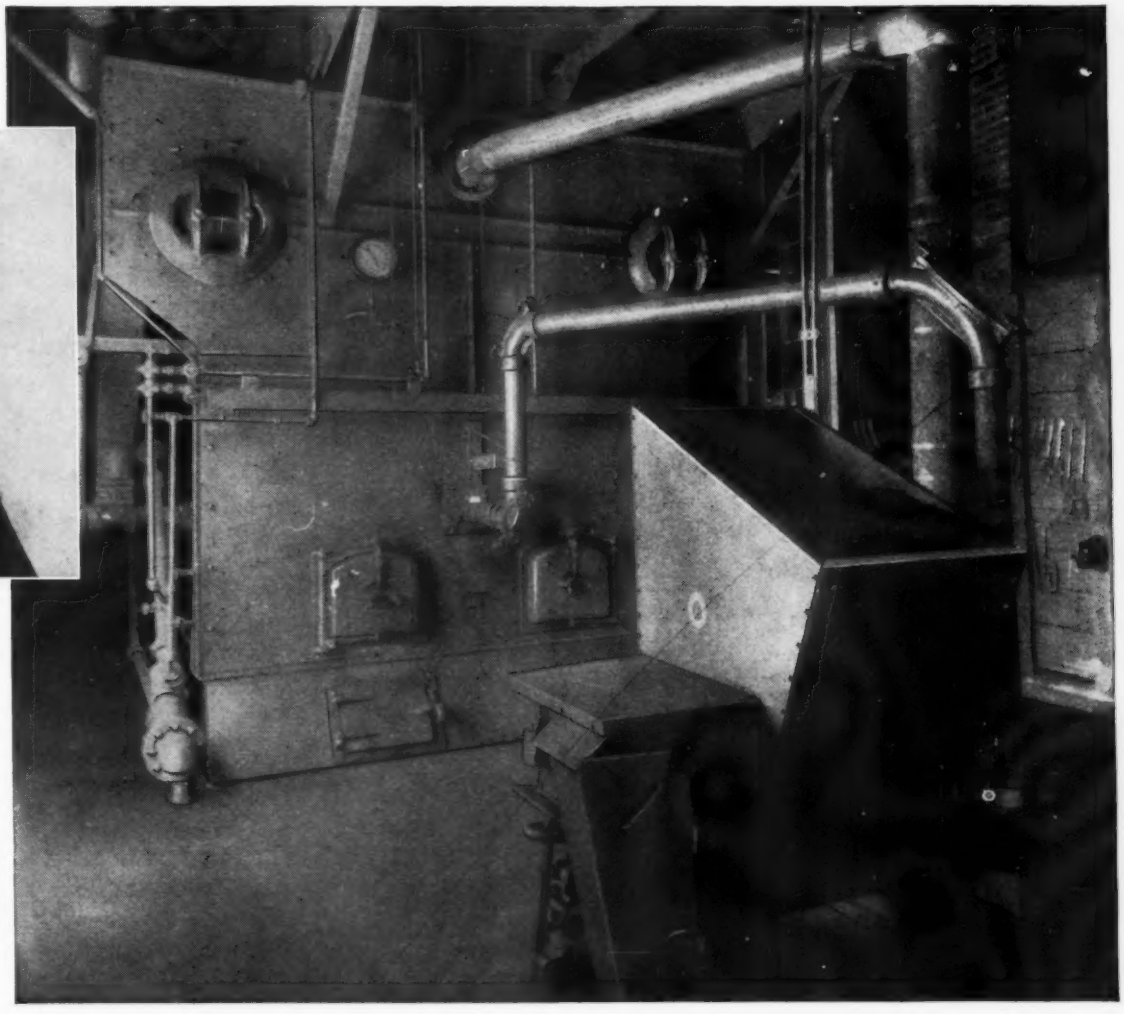
HEAVY DUTY AUTOMATIC COAL STOKERS AND INDUSTRIAL OIL BURNERS

IRON

THE IRON FIREMAN

# of Iron Fireman Stokers

Mr. H. A. Quinn, Manager, Canton (Ohio) Plant, Fame Penn Laundries, Inc.



Iron Fireman Pneumatic Spreader stoker fires the modern boiler of Canton (Ohio) Plant, Fame Penn Laundries, Inc.

26½% Saving in Fuel Costs

The Canton, Ohio, plant of Fame Penn Laundries, Inc., reported the following results 9½ months after the installation of an Iron Fireman Pneumatic Spreader stoker:

Coal costs 12½% less per ton than grade formerly used.

Tonnage of coal required has been cut 16%.

Total saving in fuel costs: 26½%.

Steam capacity has been increased.

Steam pressure now varies less than 5 pounds throughout the day.

Fireman now spends only part of his time in the boiler-room.

Smoke inspector, who had previously threatened action, has never called since installation of stoker.

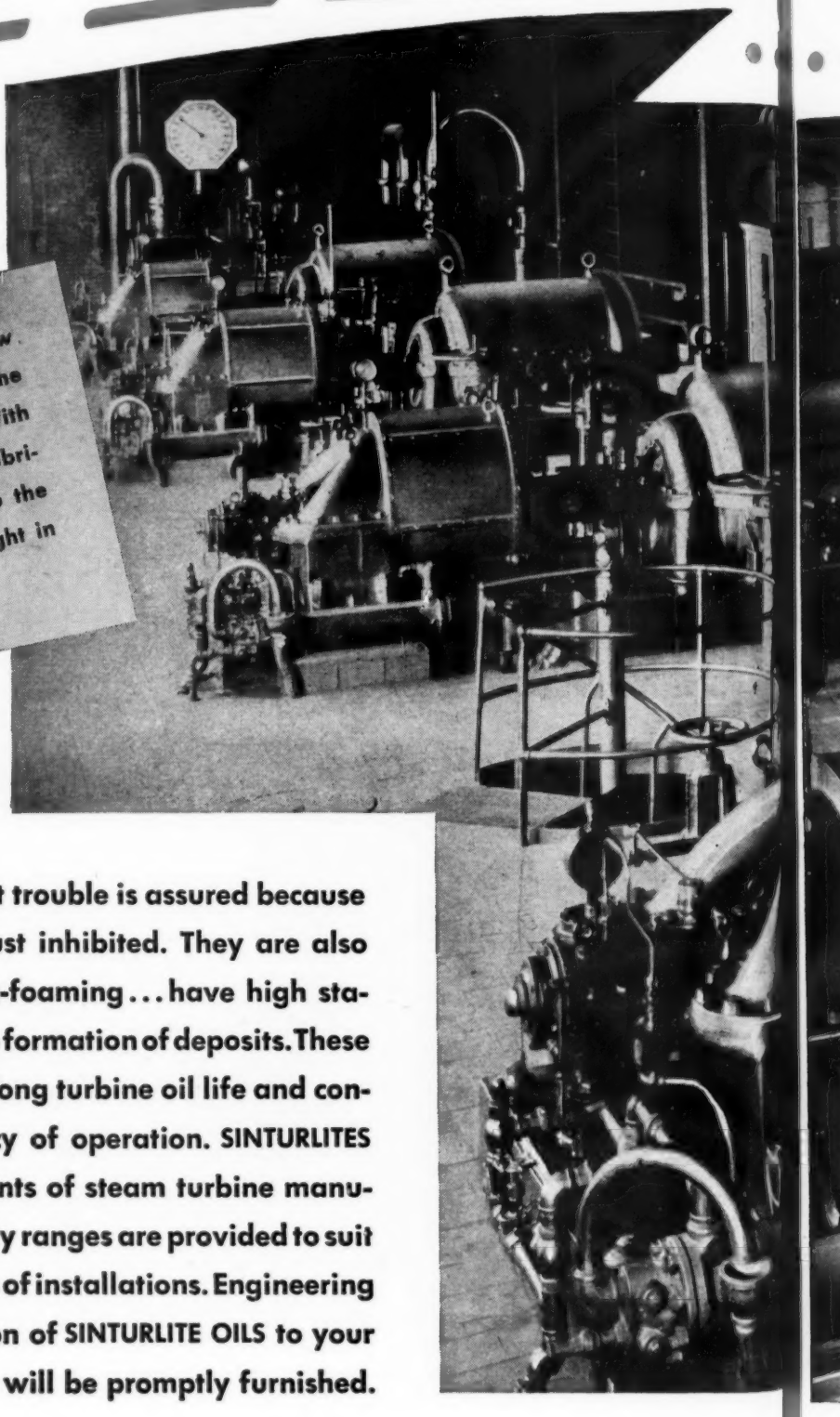
FREE BOOK on Pneumatic Spreader Stoker Firing

Contains full descriptions, capacities, operating data, etc., with layouts and photos of 10 actual installations. Sent free, on request. Write to Iron Fireman Mfg. Co., 3201 W. 106th St., Cleveland 11, Ohio.

FIREMAN

DESIGNED FOR ALL TYPES OF POWER, PROCESSING & HEATING APPLICATIONS

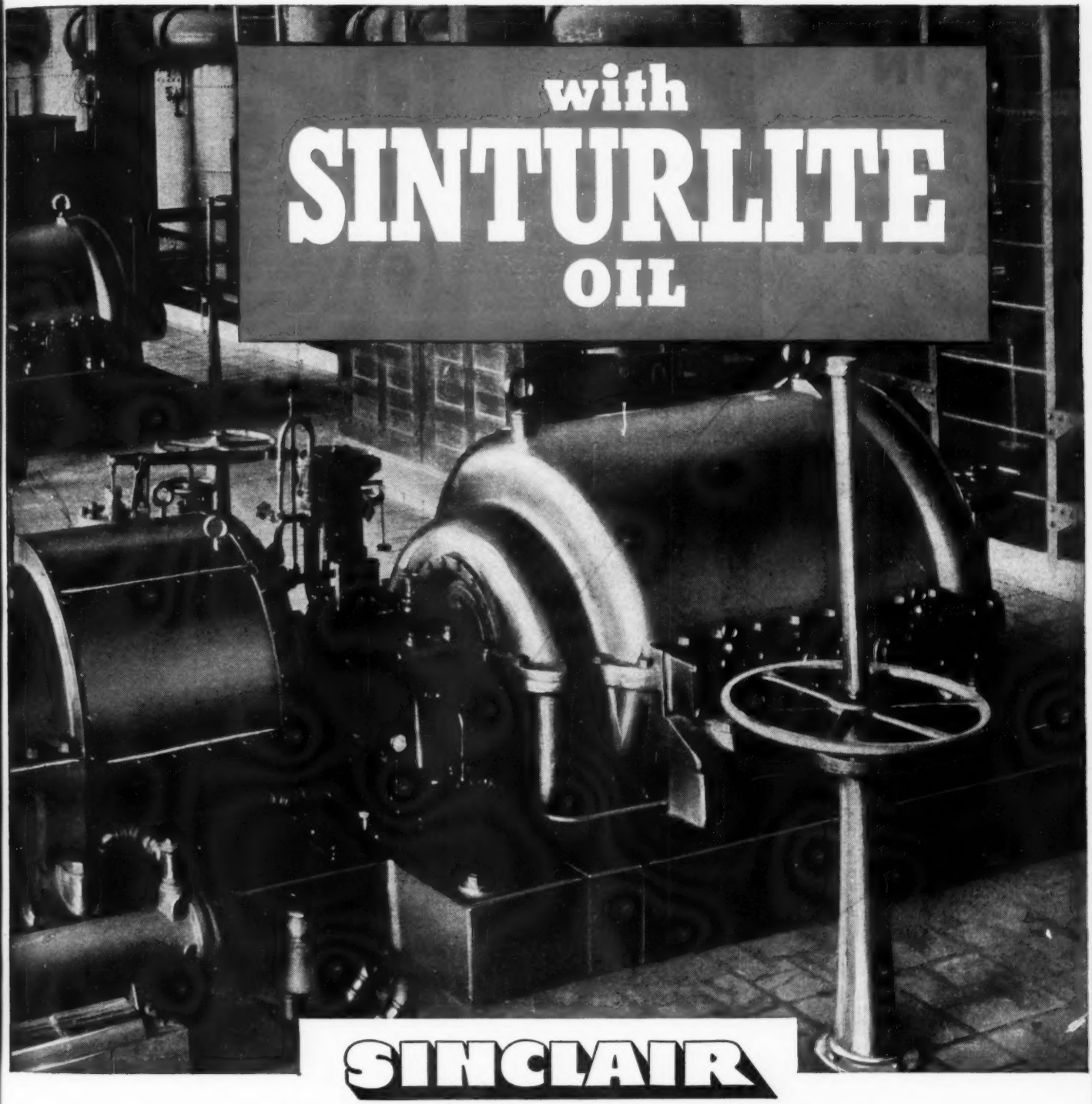
START-UP RIGHT



Rusting is a trouble common to new steam turbine systems unless the right oil is used at start-up. With Sinclair SINTURLITE OIL as the lubricant, the installation is off to the right start-up and it stays right in service operation.

Protection against rust trouble is assured because SINTURLITE OILS are rust inhibited. They are also anti-oxidant and non-foaming... have high stability and resistance to formation of deposits. These characteristics mean long turbine oil life and continuous high efficiency of operation. SINTURLITES fully meet requirements of steam turbine manufacturers. Five viscosity ranges are provided to suit varying requirements of installations. Engineering counsel on application of SINTURLITE OILS to your lubrication problems will be promptly furnished.

...and STAY RIGHT

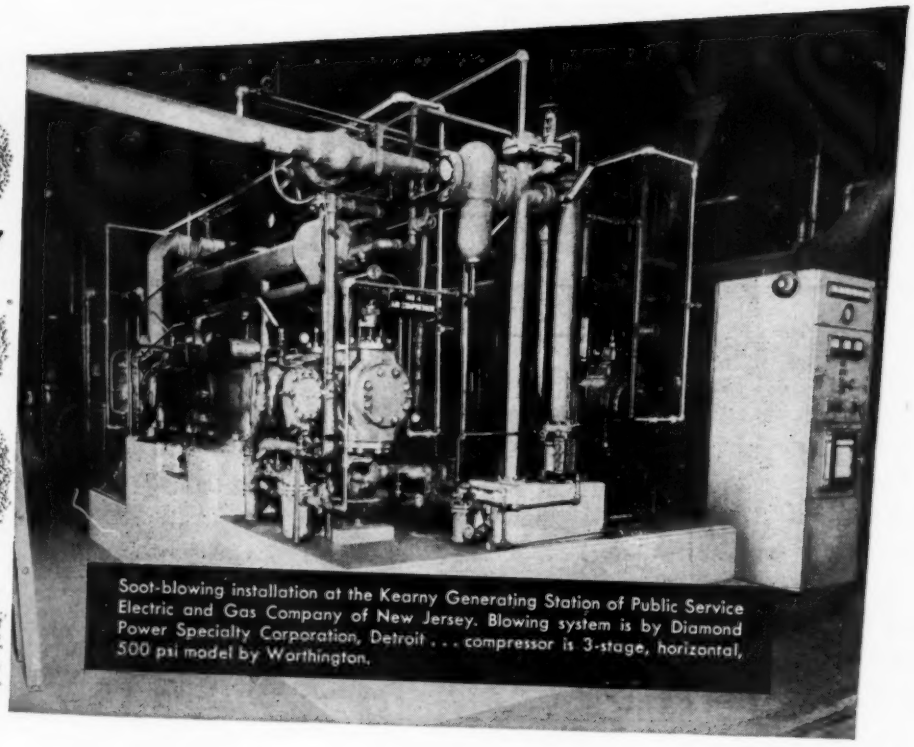


SINCLAIR

INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL
WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVE., NEW YORK 20, N. Y.

FOR TOP EFFICIENCY IN SOOT BLOWING



Soot-blowing installation at the Kearny Generating Station of Public Service Electric and Gas Company of New Jersey. Blowing system is by Diamond Power Specialty Corporation, Detroit . . . compressor is 3-stage, horizontal, 500 psi model by Worthington.

WORTHINGTON COMPRESSORS MAKE A CLEAN SWEEP

Correct boiler cleaning is yours . . . at a saving in labor . . . when you put an automatic, compressed-air soot-blowing system to work. Compressed air as a cleaning medium offers savings in fuel and savings in feed-water make-up. In addition, the possibility of tube erosion is reduced because condensate is not present in the blowing medium.

SOOT BLOWING AT KEARNY GENERATING STATION

At the Kearny Generating Station of the Public Service Electric and Gas Company, N. J., boiler cleaning became increasingly important, due to a rise in the ash content of the coal. Soot blowing with steam resulted in erosion of the tube surfaces. In addition, the replacement of water removed from the system required chemical treatment and pre-heating.

Compressed-air soot blowing overcame these disadvantages. The Kearny installation operates on an automatic cycle. In the "fog bank" section, four telescopic, long retracting units blow air at about 200 psi over the surface of the tubes, rotating 360 degrees during a projecting and retracting cycle. Short retracting blowers arranged in groups clean the boiler walls and sloping floor.

The booklet, "Worthington Compressors for Soot Blowing" proves *there's more worth in Worthington*. Write for your copy. *Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, New York.*

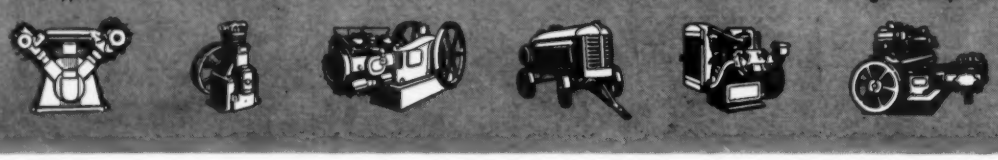
K7.17

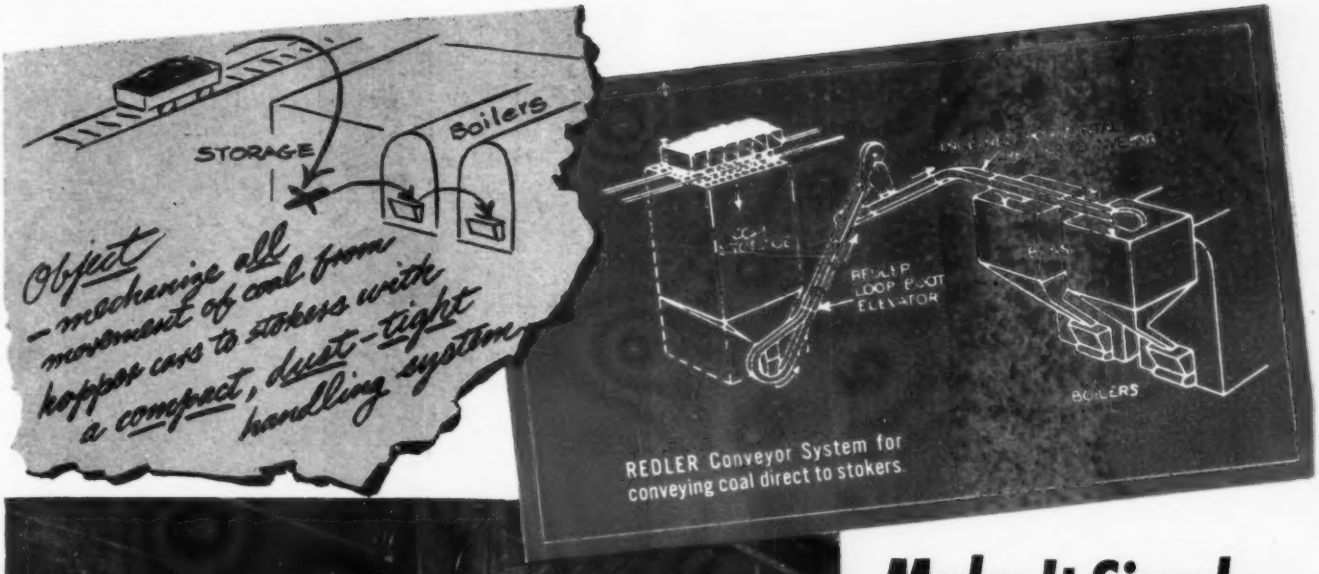
ONLY COMPRESSED-AIR SOOT BLOWING GIVES YOU ALL THESE ADVANTAGES

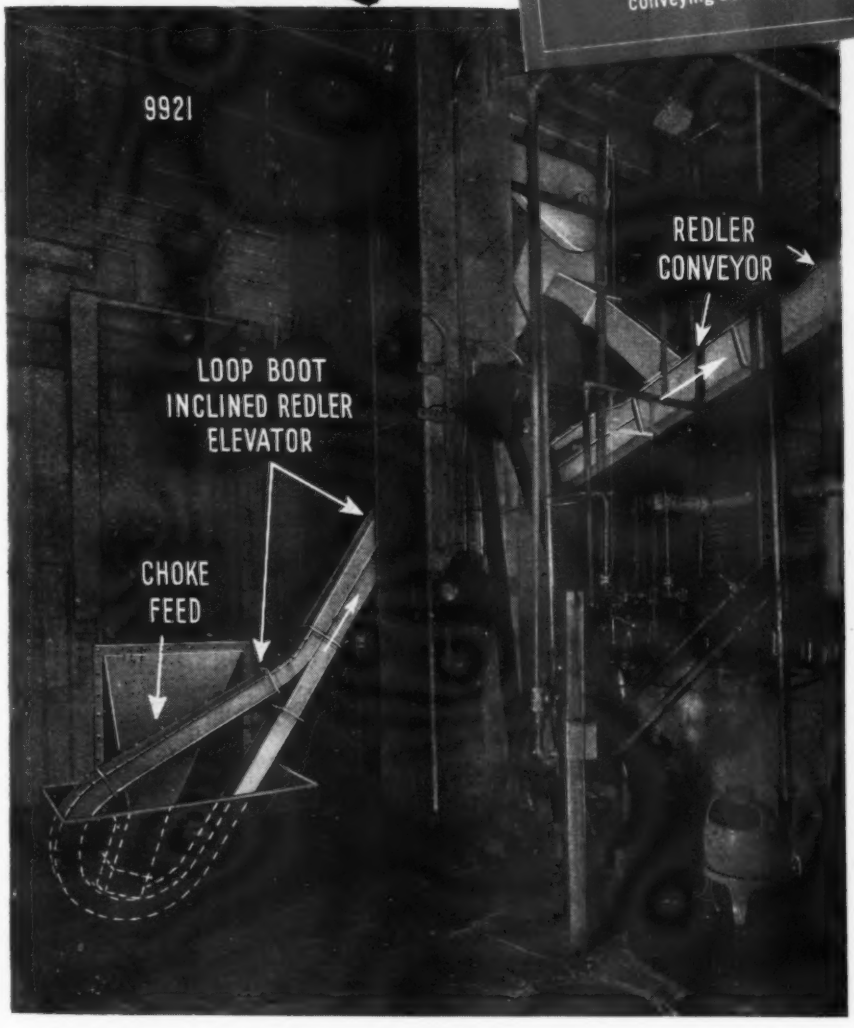
Saves Fuel . . . Saves feed-water make-up . . . Reduces possibility of tube erosion . . . Permits use of lower-cost, low-temperature piping . . . No piping insulation required . . . Reduces soot blower maintenance . . . Dryer blowing medium . . . More effective medium for slag removal.

WORTHINGTON

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON




STORAGE
Boilers
Object
– mechanize all movement of coal from hopper cars to stokers with a compact, dust-tight handling system
REDLER LOOP BOOT ELEVATOR
BOILERS
REDLER Conveyor System for conveying coal direct to stokers



Stored coal is reclaimed by an S-A REDLER Loop-Boot Elevator and fed direct to an inclined-horizontal REDLER conveyor which conveys it direct to bins over boiler stokers.

Make It Simple... Feed It Direct with REDLER CONVEYORS

• Achieving easier, lower-cost coal handling doesn't necessarily involve extensive space or changes. For proof, see the S-A system pictured above.

Coal for this power plant is discharged straight from hopper cars into a storage bin under the railroad tracks —is fed directly into the looped boot of an inclined REDLER elevator—and is then transferred to a horizontal REDLER conveyor for distribution to stoker hoppers. This installation was accomplished *without* major alterations ...occupies *very little* space...is *completely enclosed* to prevent coal dust and dirt escaping while coal is in transit.

Whatever *your* handling problem, let S-A engineers help you plan the *right* system to solve it most efficiently and economically.

STEPHEN S-A ADAMSON MFG. CO.

5 RIDGEWAY AVENUE, AURORA, ILLINOIS • LOS ANGELES, CALIF. • BELLEVILLE, ONT

Designers and Manufacturers of All Types of
BULK MATERIAL HANDLING EQUIPMENT

THE VU UNIT

for modern performance standards

For an exceptionally wide range of steam requirements – capacities, pressures and temperatures – the VU Unit assures overall performance which measures up to the best modern standards . . . as proved by records of hundreds of installations.

One of the principal reasons for the success of the VU design, originated by Combustion Engineering in 1925, is the principle of symmetry which makes every longitudinal section through the unit the same as every other.

Think what this means. Since each longitudinal section is identical . . . and the front-to-rear course of the gases assures practically constant temperature and mass flow at any given line crosswise of the unit . . . the performance of each section is identical. Therefore identical sections can be combined to provide the desired capacity at optimum overall efficiency.

Symmetrical design eliminates lazy tubes since each longitudinal section has the same furnace volume, same evaporative surface, the same amount of water, producing the same amount of steam. Moreover, the uniform release of steam along the entire length of the drum eliminates surging water level and periodic carry-over of water slugs with the steam.

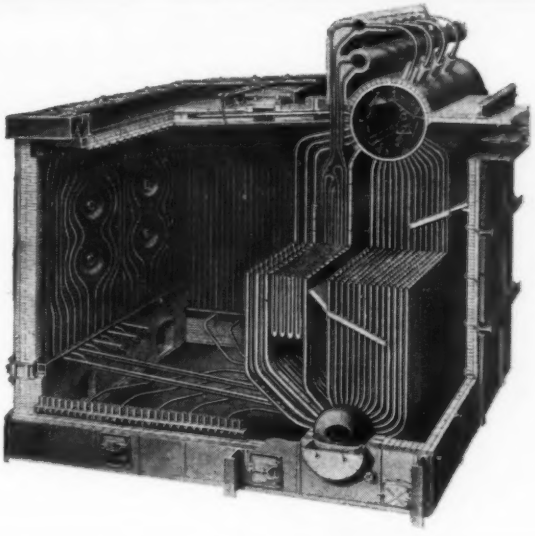
These operating advantages, combined with features assuring dependable service and low maintenance cost, have resulted in the selection of VU Units for installations throughout the United States and Canada and in many foreign countries. Aggregate capacity of these installations is now more than 70,000,000 pounds of steam per hour – a fact which speaks for itself.

The three units here illustrated comprise the VU family. They provide for capacities from 15,000 to more than 300,000 lb per hr, for pressures up to 1000 psi and for steam temperatures up to 900 F, or higher. They are adaptable to the use of any fuel or method of firing. They represent a complete answer to any and every specification of steam requirements within their capacity range.

B-141-A

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS, WATERS, ECONOMIZERS AND AIR HEATERS

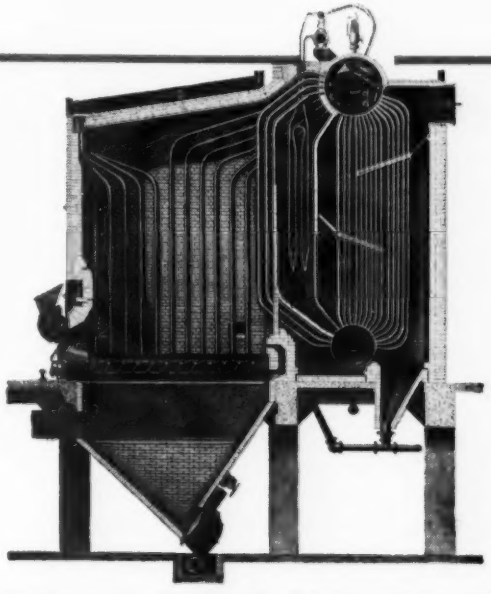


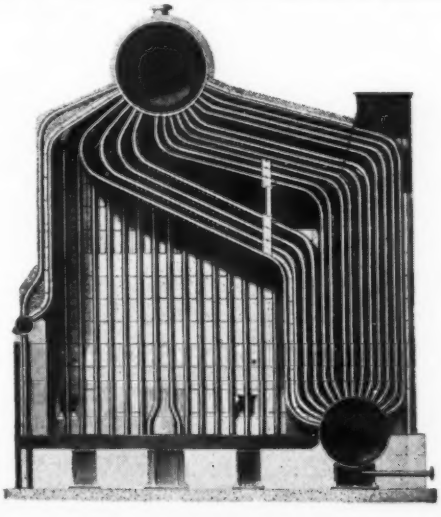
Type VU Steam Generator (for the higher capacity range)

This unit, the original VU design, may be fired by pulverized coal, oil or gas, or any combination of these fuels. Available for capacities up to 300,000, or more, lb of steam per hr, pressures up to 1000 psi and steam temperatures up to 900 F, or higher. Furnace bottom may be as shown or may be of hopper type. Economizer or air heater surface may be added.

Type VU Steam Generator (for the middle capacity range)

In this VU design, shown equipped with a C-E Spreader Stoker, the furnace proportions and arrangement of water wall surfaces may be adapted for firing by any type of mechanical stoker. Design is also adaptable for firing by oil or gas. Economizer or air heater surface may be added. Approximate capacity range 25,000 to 100,000, or more, lb per hr.





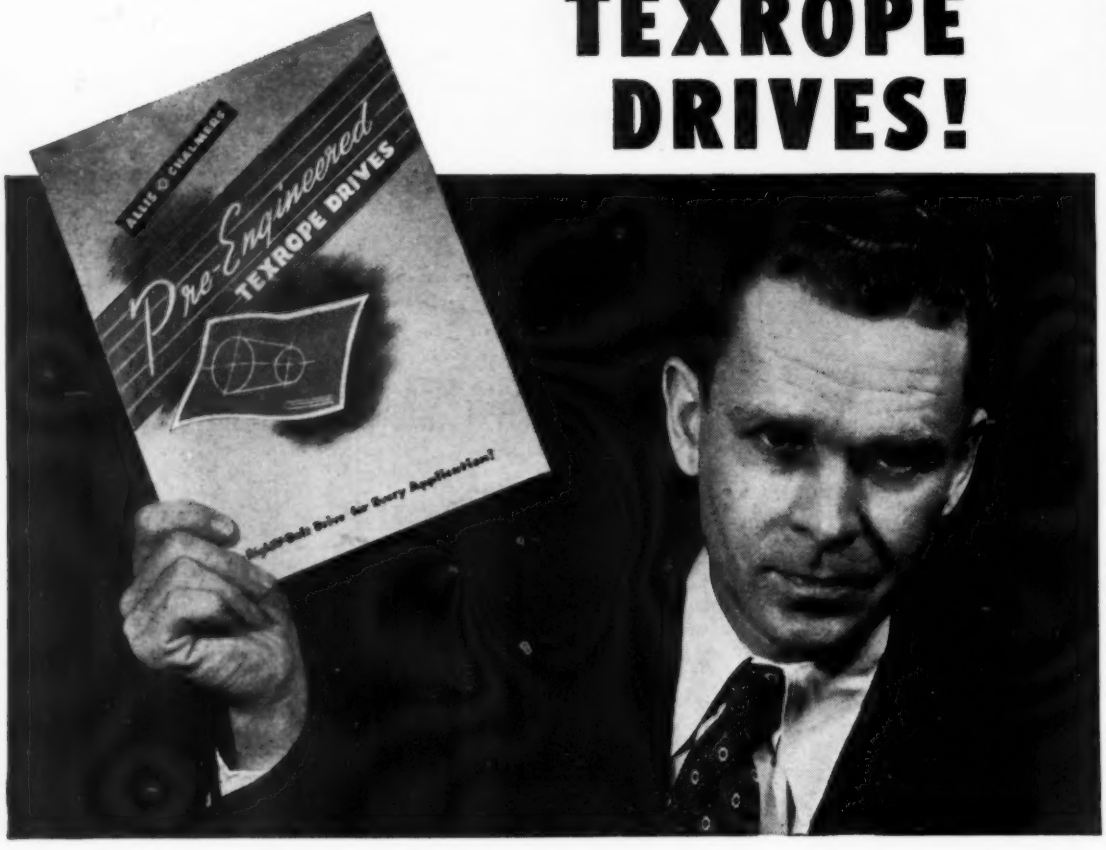
C-E Package Boiler (for the lower capacity range)

This youngest member of the VU family is designed for industrial load conditions and particularly for plants having small operating and maintenance forces. Capacities range from about 15,000 to 50,000 lb per hr. Firing may be by spreader stoker, single-retort underfeed stoker, oil or gas burners. Any of these methods may be substituted for any other, should fuel market conditions make this desirable.

ENGINEERING
200 MADISON AVENUE, NEW YORK 16, N. Y.

NEW MANUAL PRESENTS

Pre-Engineered TEXROPE DRIVES!



Selects Most Economical Drive for Any Installation!

NEVER BEFORE has specification of the *right* V-belt drive been made so simple, so unerring. You turn to a page, run down a column, and there, in *one place* is the drive you need . . . number of grooves, diameters of sheaves, size of belt. No turning from table to table, no figuring.

These *Pre-Engineered* stock Texrope drives cover 90% of all requirements. Texrope engineers have carefully selected each one, using economical *stock* belts and sheaves. Each selection is the *one best drive* for a given requirement of power, speed and dimension.

For the few cases not covered by *Pre-Engineered* stock drives, the manual provides complete, carefully arranged engineering data to make it easy to figure special drives.

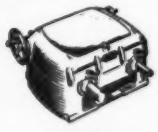
Now Available . . . 144 pages, indexed, size 8½ by 11 inches. The most complete V-belt drive manual ever published. A book that only Allis-Chalmers can give you. Copies have been sent to many Texrope dealers and users. If you have not received one, write for Texbook No. 20P40. ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 2333

TEXROPE .. Greatest Name in V-Belt Drives

"Super 7" V-BELTS
Five Types — Sizes to suit every power transmission job.

Texsteel, Texdrive, "Magic-Grip"
— sheaves in a full range of sizes, grooves.

"Vari-Pitch" SHEAVES
Exact variations in speed, stationery or motion control.



SPEED CHANGERS
Speed variations up to 375% at the turn of a crank.

ENGINEERING
Finest V-Belt engineering talent in the world—at your call.

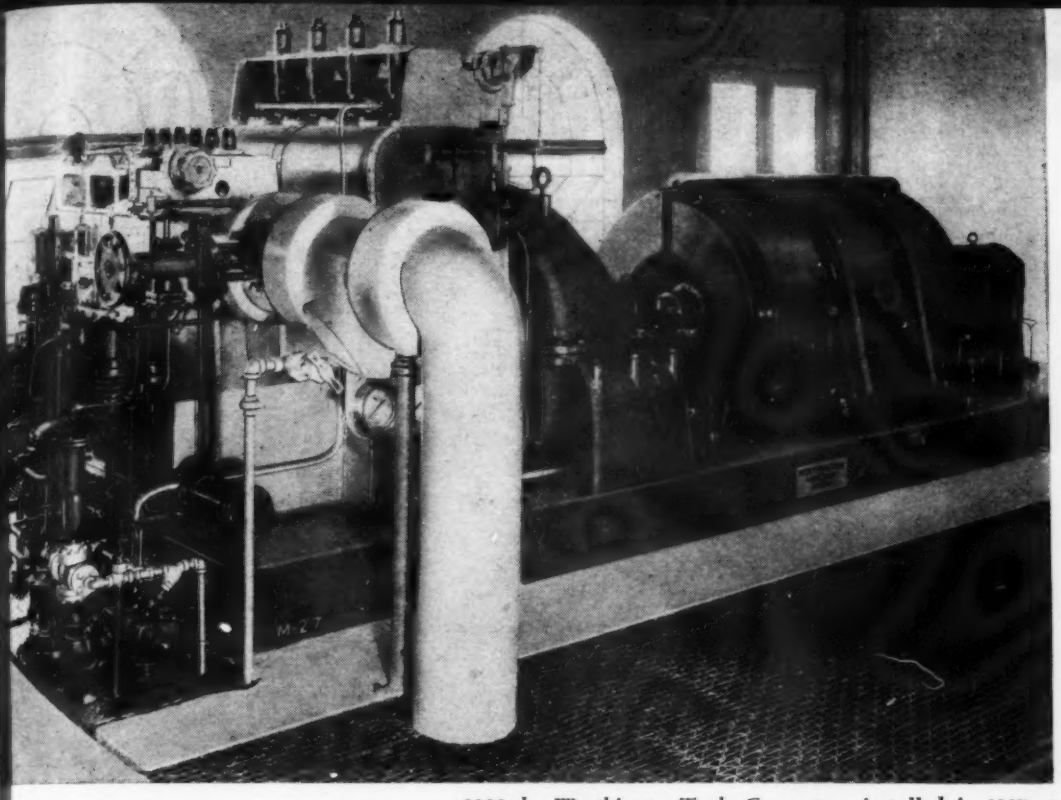
TEXROPE "Super 7" V-Belts result from the cooperative research of two great companies — Allis-Chalmers and B. F. Goodrich. They are sold only by A-C.

Texrope, Super-7, Texsteel, Texdrive, Magic-Grip and Vari-Pitch are Allis-Chalmers Trademarks

ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment — Biggest of All in Range of Industrial Products

A CENTURY OF SERVICE to Industry THAT MADE America Great



2000 kw Worthington Turbo-Generator—installed in 1937 at Detroit Lakes, Minnesota, power station.

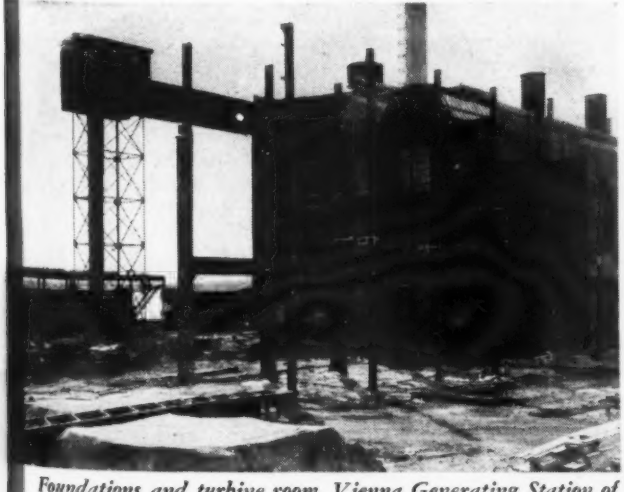
4000 kw More For Detroit Lakes

The City of Detroit Lakes, a bustling Minnesota resort center, has long taken pride in its municipally owned power plant. Through careful planning and good management, the plant has prospered . . . and the utilization of extracted steam from the generator units for heating the business district and public buildings is an advantage in Northern Minnesota measured beyond dollars and cents!

Detroit Lakes' order for a Worthington 4000 kw automatic bleeder turbine will bring to 7000 kw its total of Worthington installed turbine power. The first Worthington turbine, a 1000 kw unit, was installed in 1933; the second, a 2000 kw unit, in 1937.

The units have been inspected every two years and have been reliable and economical in operation.

Del-Mar-Va's Vienna Station Expands by Six Million



Foundations and turbine room, Vienna Generating Station of Eastern Shore Public Service Company of Maryland (United Engineers & Constructors, Inc., Philadelphia).

To provide more electrical energy to the Del-Mar-Va Peninsula, the Eastern Shore Public Service Company, a subsidiary of the Delaware Power and Light Company, is now undertaking a $6,000,000 expansion of its station in Vienna, Maryland.

Worthington was recently awarded the contract for the condensing unit to serve the latest 15,000 kw Turbo-Generator: a 14,000 sq-ft two-pass condenser with auxiliary equipment.

Four units are now in operation in this station—two 6,000 kw and two 7,500 kw. One 15,000 kw unit is being installed by the United Engineers and Constructors and a similar unit is on order. The two 6,000 kw generators operate at 300 psi, 675F, TT; the 7,500 kw and 15,000 kw units operate at 650 psi, 825F, TT.

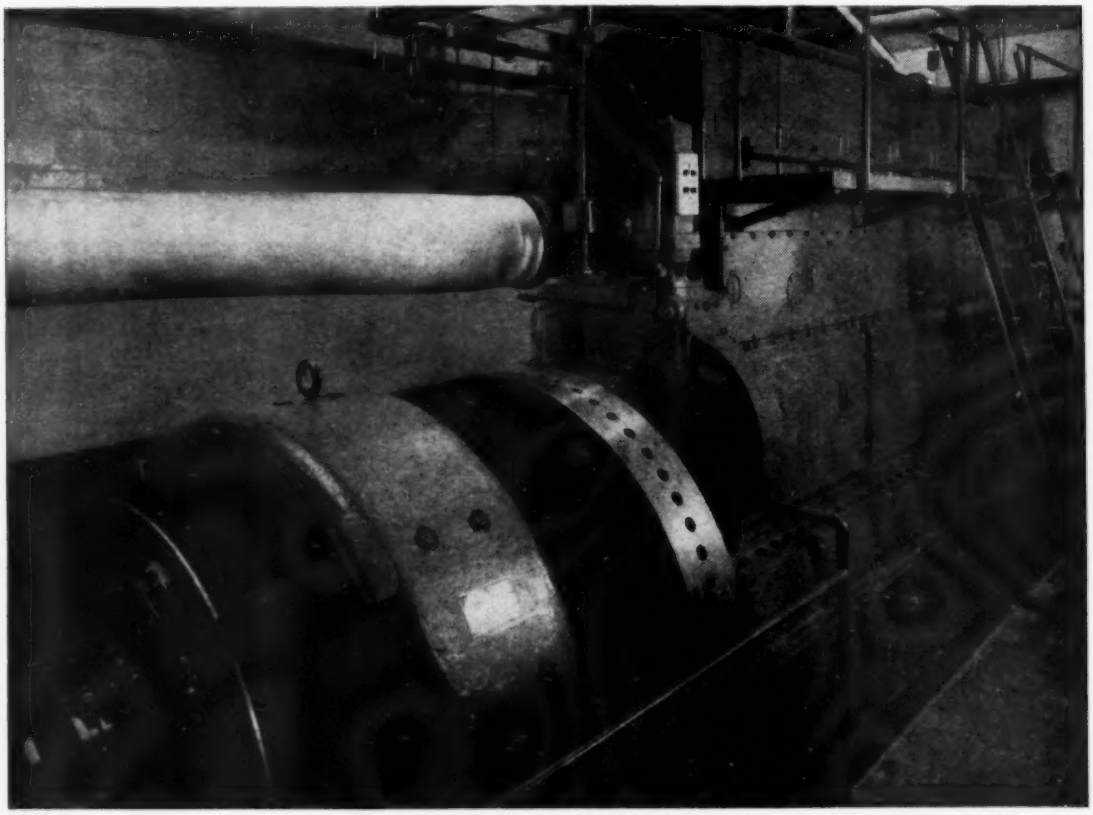
NEWS

FROM THE POWER FRONT

AS REPORTED BY THE DEVELOPMENT ENGINEERS, FIELD SERVICE REPRESENTATIVES AND CUSTOMERS OF WORTHINGTON

WORTHINGTON PUMP AND MACHINERY CORPORATION, HARRISON, N. J.

NEWS from the power front



Worthington 750 hp Type EE-6 Diesel Engine at Lenox Hill Hospital.

Worthington Diesel at Lenox Hill Hospital

A 750 hp Type EE-6 Worthington Diesel engine installed in the power plant of Lenox Hill Hospital in New York City has helped to produce substantial savings in the cost of producing power during each operating month as compared with the previous steam engine installation.

Prior to the installation of the Diesel generating unit, power was furnished for 20 hours per day by a 400 kw steam engine generator unit, and during the balance of the day small steam engine generating units of 75 and 125 kw carried the load. With this arrangement, opportunity for adequate maintenance of the large engine unit was extremely limited. Then, too, during the warm weather months when demand for exhaust steam was at a minimum, a large amount of steam was wasted.

The new Diesel unit is the perfect answer to both these problems, being available at any time as standby for the large steam unit and eliminating the waste of exhaust steam during the warm months when it runs continuously.

The Diesel is a 6 cylinder, four cycle engine having 16 in. bore and 20 in. stroke. The starting air is supplied at 250 psi by a Worthington two-stage compressor. Jacket water, raw water and waste heat boiler feed pumps were all supplied by Worthington.

Million Dollar Baby

Installation of Model C Worthington Allspeed Selectors, at The Floyd A. Holes Co. plant in Bedford, Ohio, finally brought a well-deserved lay-off to a Model A Allspeed Selector purchased during the early part of the war.

It was originally put to work on a laminating machine making Grade C Type I ordnance wrap. The machine was then equipped with a ¾ hp motor. For a long time, the equipment was operated as hard as possible—from high speed to low speed about every 1½ minutes for 24 hours a day, seven days a week.

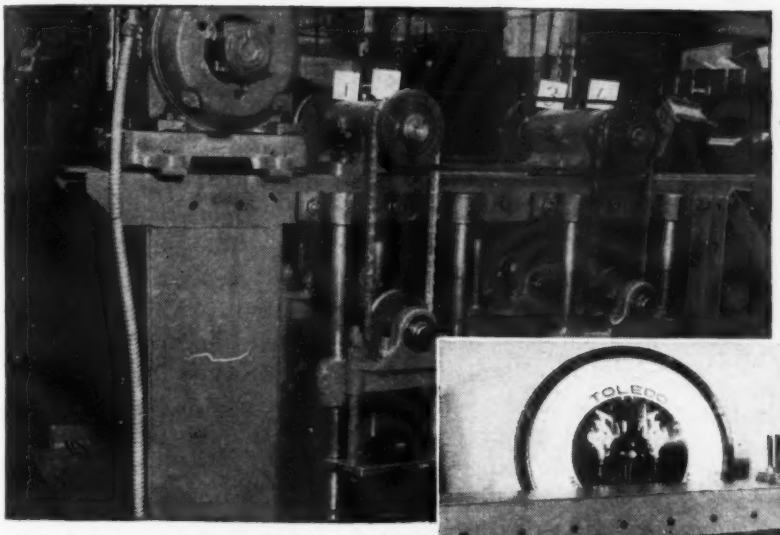
Then a 1 hp motor was installed —and later, a 2 hp motor. Finally, the drive—not intended for such heavy service—began to falter and was replaced with the larger Selector.

Mr. F. A. Holes reports:
"That little drive produced over a million dollars worth of Grade C Type I before we finally removed it from that operation. Since that time, we have placed it on several smaller operations, and we want you to know that it is still working perfectly today whenever we have occasion to use it. We believe that this is indeed a complimentary record for this piece of equipment and felt that you would like to know about it."

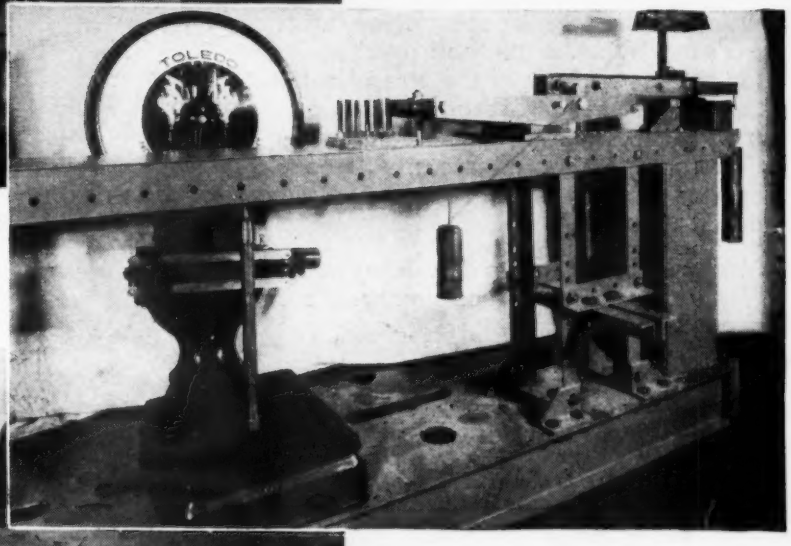
Worthington Pump and Machinery Corporation
Harrison, N. J.

NEWS

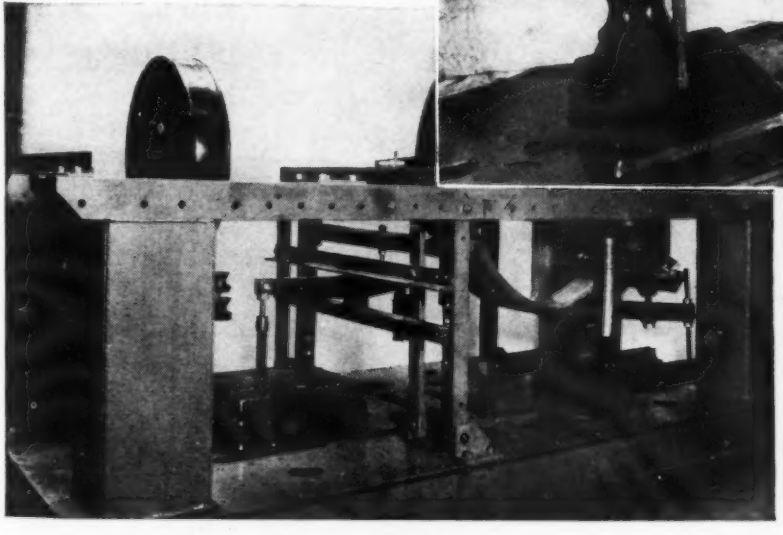
Universal Test Stand for Worthington Multi-V-Drives



Typical set-up of fixtures for comparative testing of Vee Belts to determine flex life and endurance under various speeds and loads. Photos taken in Worthington's Multi-V-Drive Research and Development Engineering Dept.



This fixture tests various kinds of steel and heat treatment on QD sheave hub pull-up bolts for wrench torque, elongation, elastic limit, ultimate strength and distortion in the thread lead relative to pulling power of bolt.



Static torque testing apparatus with rating up to 200,000 inch pounds torque determines cone grip capacity of QD sheaves and hubs. It permits mechanical or electric detection of cone slip in minute proportions.

It's a Long Drink from Arkansas to Chicago

Mountain Valley Water Company supplies bottled water to thirsty Chicagoans, all the way from Hot Springs, Arkansas. Until this past summer, the water had been shipped in 30-gallon drums. Unloading these drums from freight cars at the Chicago end took four men about five hours per freight car load of 5500 gallons.

Last May two 8000-gallon tank cars were leased. When the water arrives in Chicago, the tank is hooked up with a Worthington Monobloc Centrifugal pump in the basement of the bottling plant, and within two hours, the water has all been transferred to stainless steel storage tanks on the fourth floor of the building. Labor cost involved is just for starting and stopping the pump motor.

The pump is 3 hp, 3600 rpm, with a 3-phase, 220/440 volt drip-proof motor.

Meeting your steam requirements with CONTROLLED SUPERHEAT over WIDE LOAD RANGES

A METHOD of superheat control which successfully overcomes the disadvantages of methods such as damper by-pass, "desuperheating" by spraying water into steam, and others, has been developed and applied to Foster Wheeler steam generators.

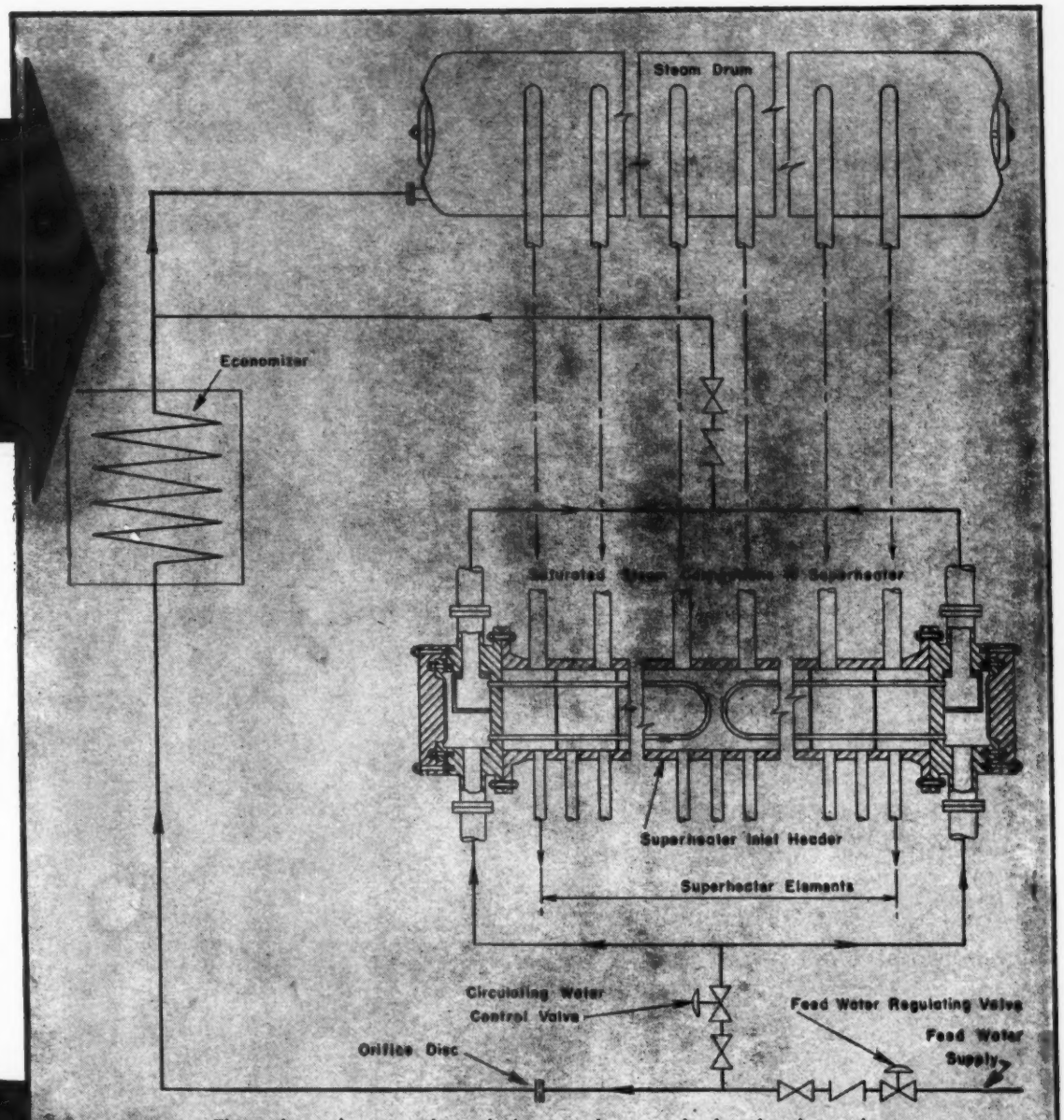
The Foster Wheeler method operates by reducing the latent heat of the steam in the superheater inlet header. It differs from conventional desuperheating because no water is added to superheated steam. Simply, superheating becomes a controlled operation from inlet to outlet.

Boiler feedwater is diverted around the economizer and passed through tube bundles located in the superheater inlet header. This relatively cool feedwater condenses some of the entering cleaned and dried steam. The amount of moisture entering the superheater is regulated to provide positive and accurate control of final temperature. In addition to the wide range control possible when this device is used, superheated steam is not contaminated by water, and excessive metal stresses are avoided.

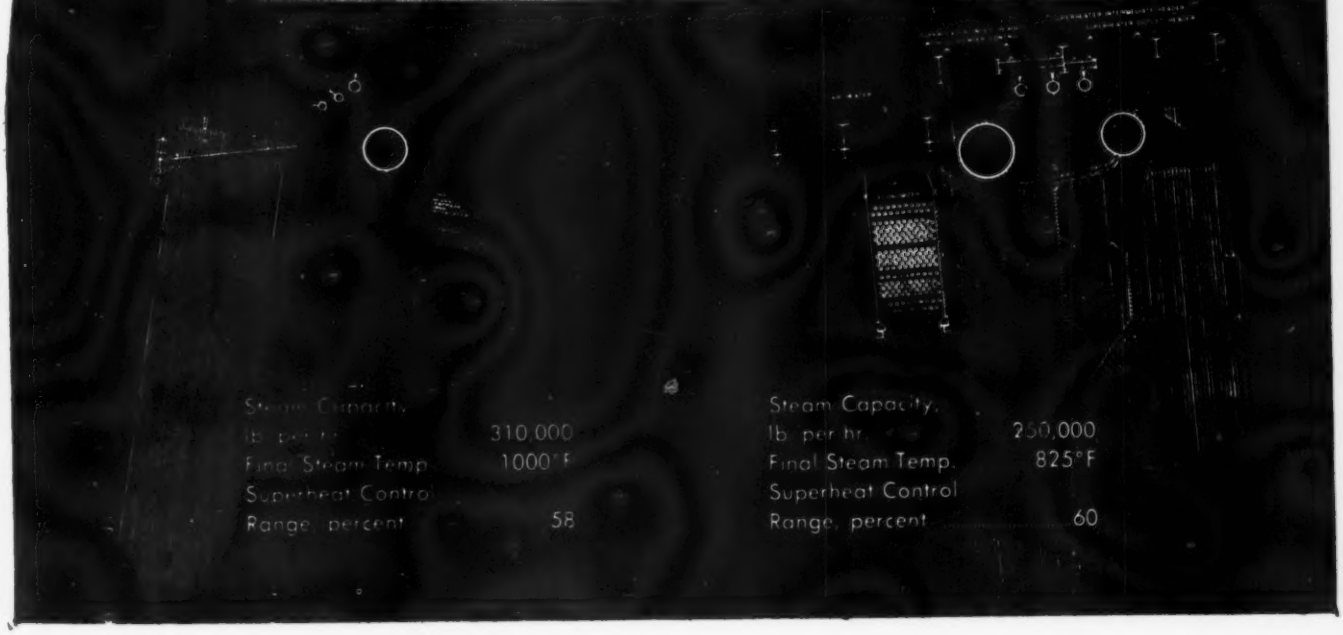
A reprint of an article describing in detail a specific application of Foster Wheeler condenser-type superheat control is available. Ask for B-46-20.

FOSTER WHEELER CORPORATION

165 BROADWAY, NEW YORK 6, NEW YORK



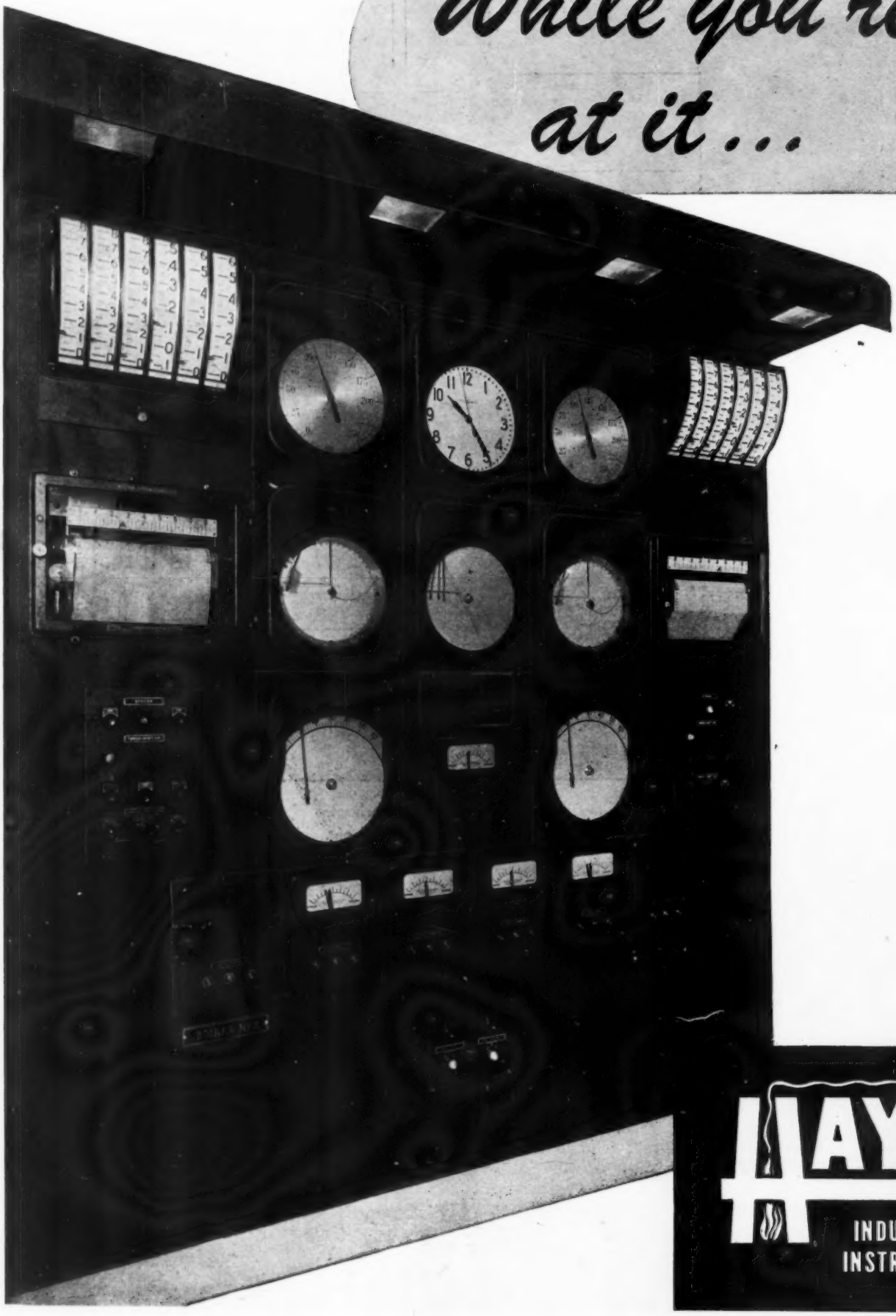
This enlarged section through the superheater inlet header shows the arrangement of condenser-type control of final steam temperature.



Steam Capacity, lb per hr	310,000
Final Steam Temp.	1000°F
Superheat Control Range, percent	58

Steam Capacity, lb per hr	250,000
Final Steam Temp.	825°F
Superheat Control Range, percent	60

While you're at it...



HAYS
INDUSTRIAL INSTRUMENTS

PUT IN THIS MODERN SYSTEM—

HAYS Automatic COMBUSTION CONTROL

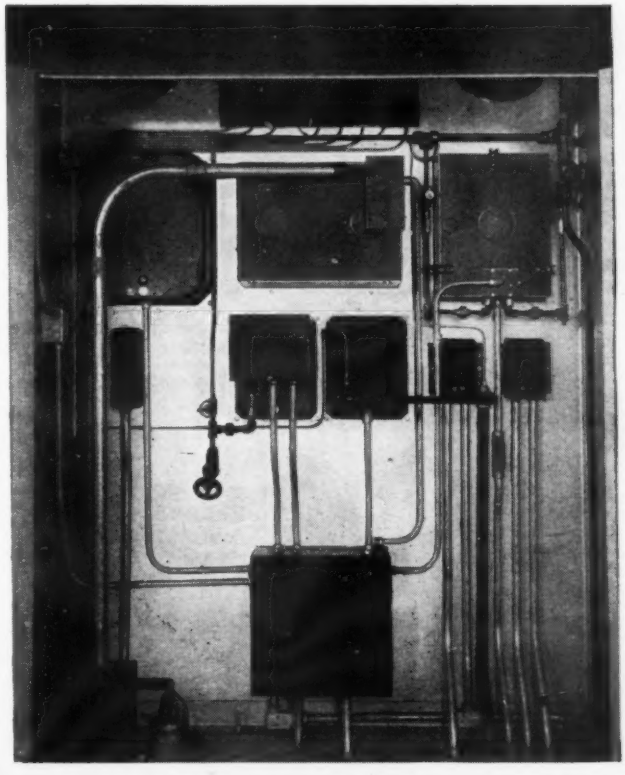
it's Electrical

ACCURATE, SIMPLE, DEPENDABLE, Hays centralized automatic combustion control is the truly modern method.

It is wholly electrical. Every combustion variable is measured accurately and corrected instantly. Sensitive contacts are operated by enclosed mercury switches—no possibility of moisture or dust; no sticking, chattering or excessive wear. Adjustments are made direct—no dependence on air pressures, oil pressures and intricate valve systems required in non-electrical designs. It is easy to install, easy to operate, easy to maintain.

For full details write for Bulletin 46-605—contains schematic drawings of 14 typical installations.

THE HAYS CORPORATION
Michigan City, Indiana



These six potent features tell a quick convincing story of Hays advantages:

1. **All Electric operation.**
2. **Simple, positive, modern.**
3. **Easy for operators to understand, operate, maintain.**
4. **For all sizes of steam generating systems burning *any kind of fuel*.**
5. **A thoroughly engineered installation by a Hays representative . . . Hays engineer representatives in all principal cities.**
6. **Every variable is accurately measured and proper corrections made *instantly*—electrically.**

View is of panel from the rear with access doors open to show the workmanlike wiring and the accessibility of all instruments and controllers. This type of fine workmanship is standard with Hays.

Automatic **COMBUSTION CONTROL**

INDUSTRIAL CONTROL · FLOWMETERS · GAS ANALYZERS · DRAFT GAGES · CO_2 RECORDERS

PROBLEM IN *Flow Control?*

Fig. 1793—Large 125-pound Iron Body Bronze Mounted Gate Valve. Made in sizes 2" to 30", incl. Has outside screw rising stem, bolted flanged yoke and taper wedge solid disc.

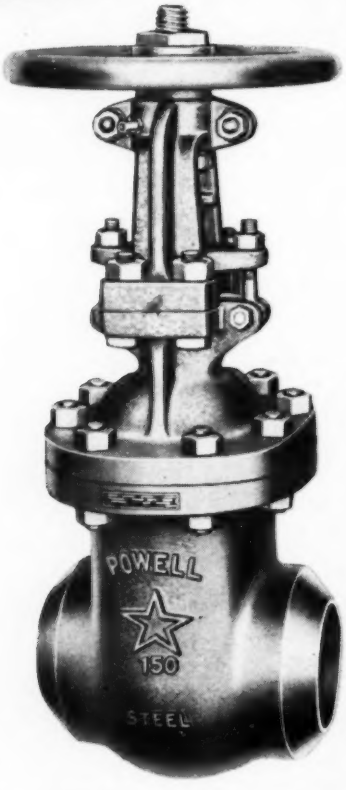


Fig. 1503 W. E.—Class 150 - pound Cast Steel Gate Valve with welding ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc.

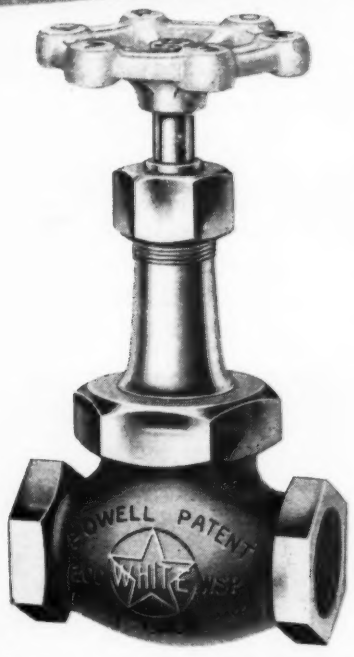


Fig. 1708—200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable, specially heat treated stainless steel seat and regrindable, renewable, wear-resisting "Powellium" nickel-bronze disc.

Fig. 559—125-pound Iron Body Bronze Mounted Swing Check Valve. Flanged ends, bolted flanged cap and regrindable, renewable bronze seat and disc.

POWELL

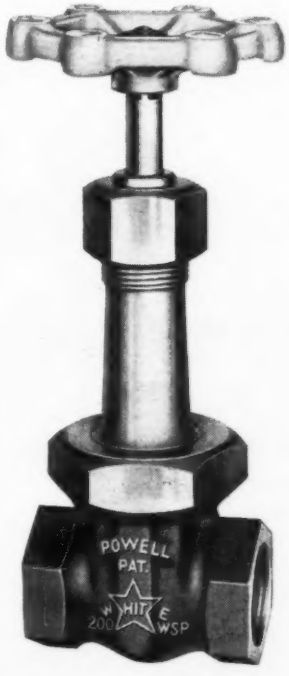
. . . .the answer is—

POWELL *Valves*

Through the years of amazing growth and diversification of industry, problems in flow control have become increasingly numerous and more complex.

But in more than a century of specializing in making valves—and valves only—Powell has never failed to solve a problem as it has arisen.

Keeping pace with every new requirement in the power field, Powell has developed a complete line of Bronze and Iron Valves of all necessary types, designs and pressures and an equally complete line of Cast Steel Valves—Gates, Globes, Angles, Checks and Non-returns—in pressure classes from 150 to 2500 pounds.



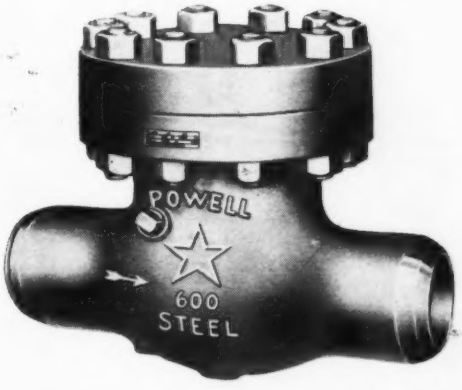


Fig. 6061 W. E.—Class 600-pound Cast Steel Swing Check Valve with welding ends and bolted cap. Disc has ample lift to permit full straightway unobstructed flow through the valve body.

Fig. 375—200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable, wear-resisting "Powellium" nickel-bronze disc.

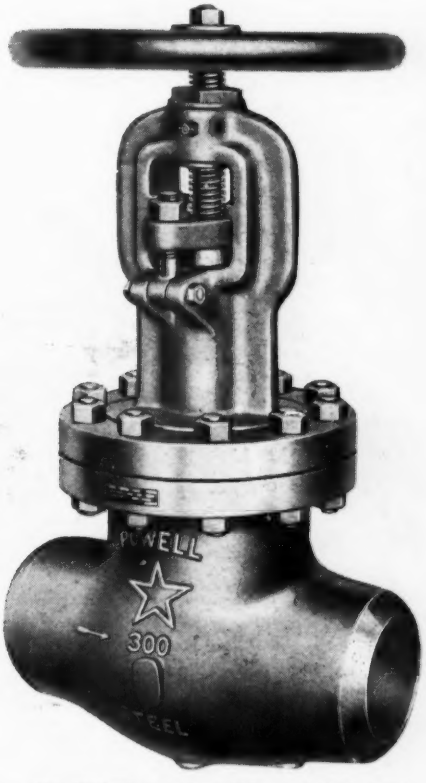


Fig. 3031 W. E.—Class 300-pound Cast Steel Globe Valve with welding ends, outside screw rising stem and bolted flanged yoke.

The Wm. Powell Co., Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

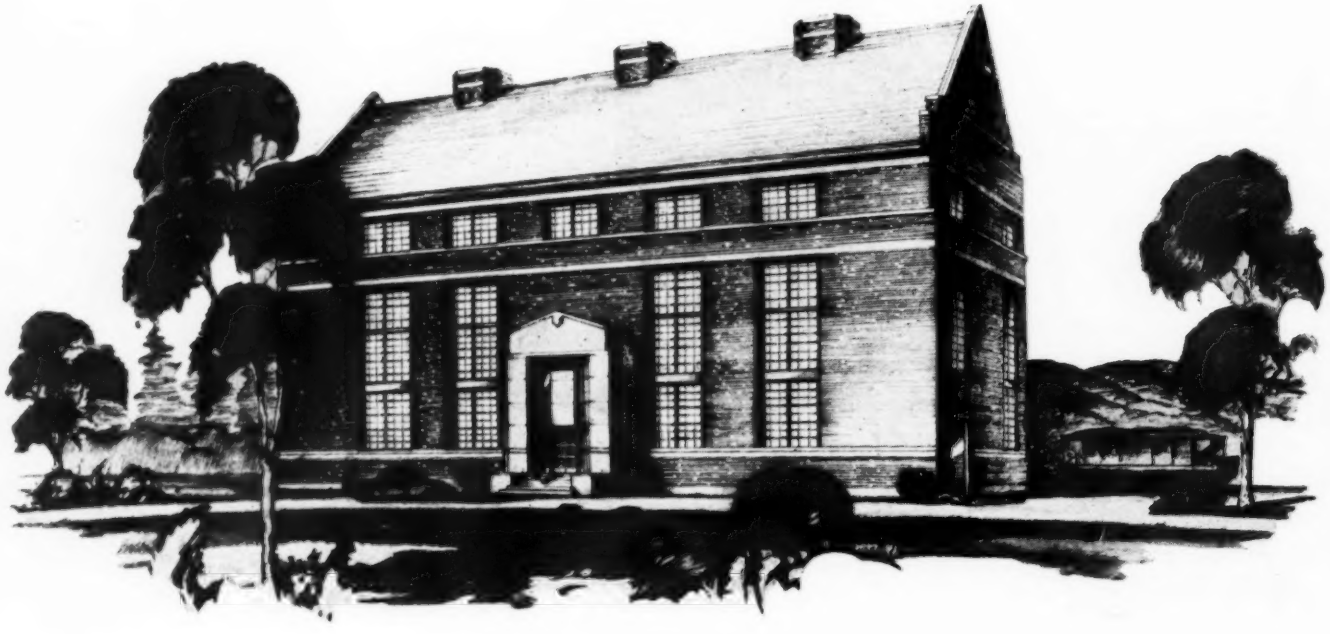
VALVES

MODERN DESIGN AND EFFICIENCY GO HAND IN HAND WITH WICKES QUALITY AT *Michigan State College* EAST LANSING, MICHIGAN

This modern steam generation plant pictured below houses the *eleventh* Wickes Boiler installed at Michigan State College with space provided for the 12th unit.

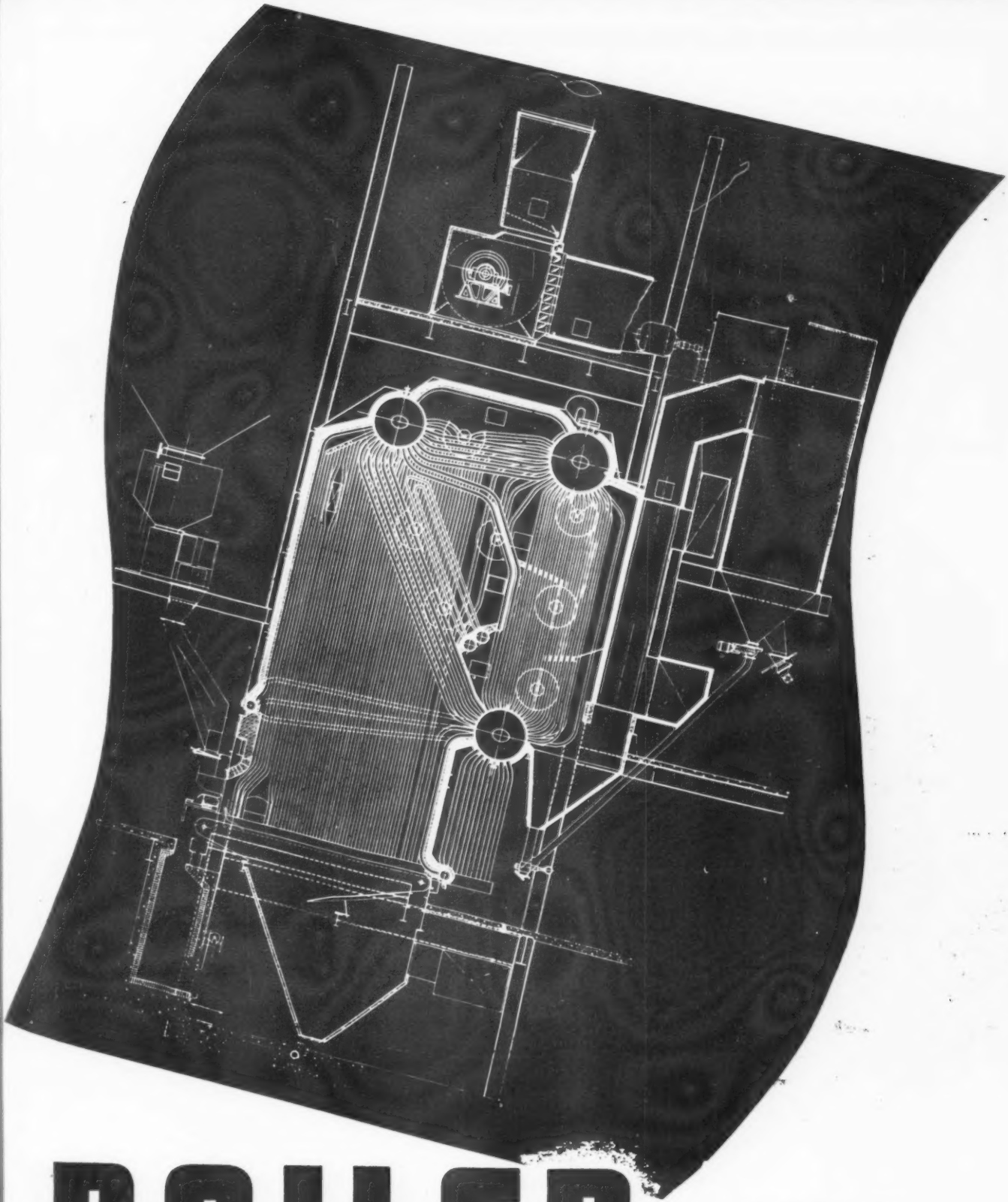
Working to the specifications of Claud R. Erickson, consulting engineer of Lansing, Michigan, Wickes designed a 3-drum boiler that makes this installation the *most modern, efficient generation plant* to be found at any educational institution in the country. Boiler specifications: capacity, 125,000 lb. per hr.; design pressure, 350 psi; total steam temperature, 550°F

Wickes has the engineers, the manufacturing facilities, and the skilled workmen to fill your requirements for *boilers of any type up to 250,000 lb. steam per hour and 850 psi.* Your inquiries will receive prompt attention.



WICKES

RECOGNIZED QUALITY SINCE 1854



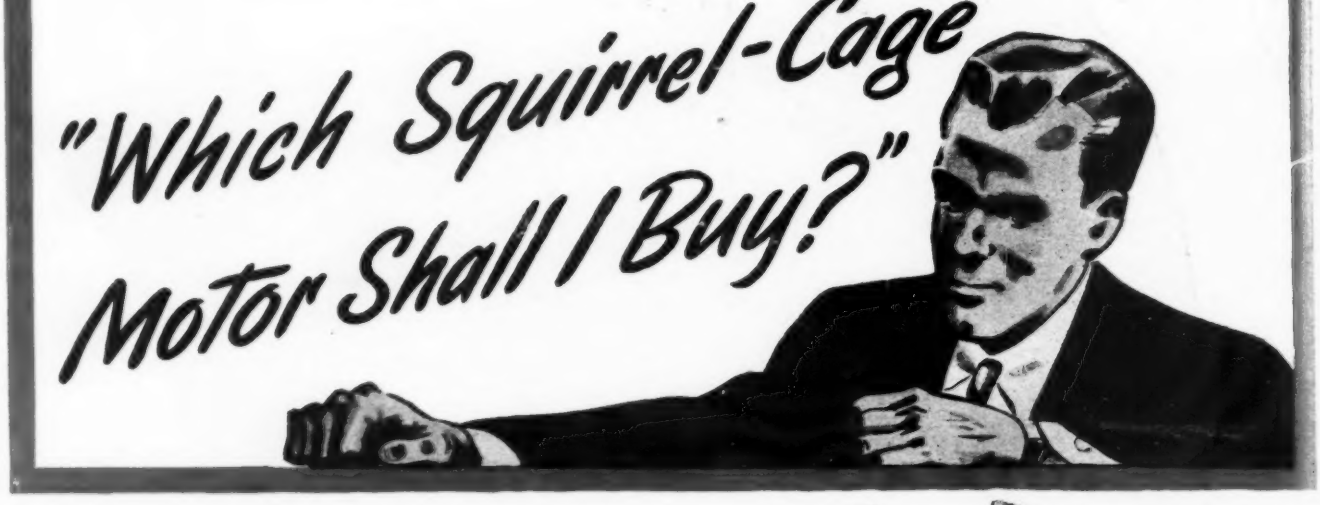
BOILER

DIVISION OF THE
WICKES CORPORATION

SAGINAW, MICHIGAN

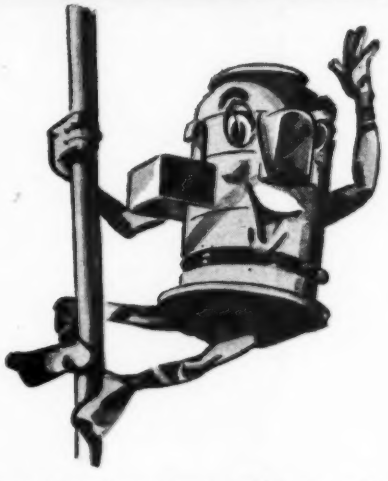
SALES OFFICES: Atlanta • Boston • Charlotte, N. C. • Chicago • Cincinnati • Denver • Detroit
Houston, Texas • Indianapolis • Kansas City • Los Angeles • Milwaukee • New York City
Peoria, Illinois • Pittsburgh • Saginaw • San Francisco • San Jose, Calif • Seattle • St. Louis
Tulsa, Okla. • Mexico City

"Which Squirrel-Cage Motor Shall I Buy?"



Open-Type? This general-purpose squirrel-cage motor meets about 9 out of every 10 application requirements; so chances are it's the design you'll select. Allis-Chalmers builds generously proportioned, rugged *open-type* squirrel-cage motors in sizes from 1 hp to the largest practical requirement.

Splash-Proof? Where operating conditions are conducive to entrance of particles or liquids into ordinary motors from either top or sides, Allis-Chalmers *splash-proof* squirrel-cage motors may be your best buy. They're designed to *exclude* top or side directed particles and liquids. Sizes 1 hp to the largest.



Vertical? or Flange-Type? *Either* can solve a space problem. *Vertical* motors (sizes 1 hp to largest) for vertical drives. *Flange-mounted* for side or angle drives. In both types bearings and closures are designed to prevent grease escapement. Mounting flange for attaching to your base can be provided.

Totally-Enclosed? Explosion-Proof? Completely weather-proof and fan-cooled, these motors are built to beat abrasive dust, dirt and corrosive fumes, or moisture conditions that cause windings in ordinary motors to deteriorate. *Explosion-proof type* for oil refineries, paint, varnish or lacquer plants, etc.; Underwriters approved; reduce hazards in explosive or dust atmospheres. Either type built from 1 hp and up.

Are Motor Decisions More Important Today?

YOU BET THEY ARE! One *obvious* reason is the need for keeping costs down. Another is that in the rush to fill demand much equipment is being misapplied; making it harder to maintain profits not alone today, but tomorrow, the next day and the next year—as long as misapplication continues!

That's why it's important to take a good look at motors — their characteristics — your equipment — power source and surroundings — *before* you buy and apply! If you're in doubt, don't take chances — call a motor expert! ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 2327

A CENTURY OF SERVICE to Industry THAT MADE America Great

ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment-
Biggest of All in Range of Industrial Products

Remember this Fan . . .

You don't have to baby the new Moore fans and blowers. Rugged and corrosion-resistant, you can install them and forget them. Read why!

The Moore Company of Kansas City, Mo., realized that pressure fan users were getting fed up with breakdowns and time-consuming servicing of their air-moving equipment.

So, this company decided to design a blower . . . from start to finish . . . that would give extra-long life and trouble-free performance.

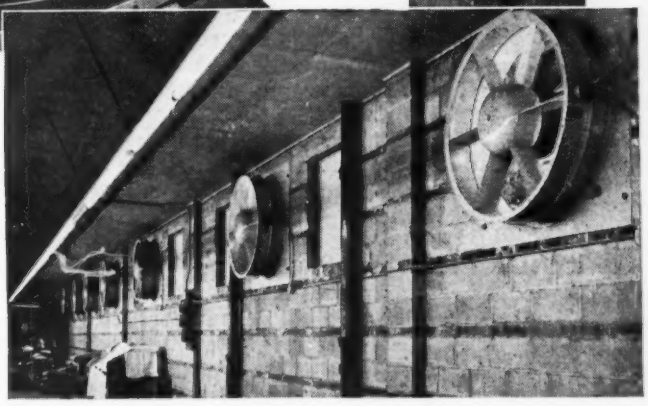
In the hub of their new unit, they built a heavy-duty, direct-drive motor. This has only one moving part . . . the rotor to which the fan is attached.

The entire motor assembly is isolated by soft synthetic rubber mounts. Bearings are permanently lubricated and sealed.

But, that's not all. Moore engineers also realized that corrosion figured heavily in fan failures. Blades, guide vanes, hubs, and rims must withstand damp or steamy atmospheres, smoke, coal dust . . . or even acid fumes.

The one metal Moore found to lick all these conditions was the INCO *Nickel Alloy . . . MONEL*.*

In addition to its corrosion resistance, Monel also fights abrasion. And, it's as strong as structural steel. Thus, the curved and formed fan sections are thinner and far lighter than cast parts . . . without sacrificing strength.



Moore direct-drive ventilating fans and pressure blowers are available from 36" to 96" in diameter, with capacities up to 125,000 cu. ft. per minute. Other Moore fans range up to 24 ft. in diameter, capacities of more than 1,000,000 C.F.M. Made of tough, corrosion-resistant Monel, they are used today by power stations, foundries, oil refineries, textile mills, and many other industrial plants. For detailed information, address The Moore Company, 544 Westport Road, Kansas City 2, Missouri.

* * * *

The above is another example of how strong, long-lasting INCO Nickel Alloys are serving modern power plants. Other applications include preheater tubing, valves, pump parts, fittings, and gaskets.

If *you* are looking for one metal to solve a tough combination of problems, find out more about the family of INCO Nickel Alloys. Full technical information and assistance are yours for the asking.

*Reg. U. S. Pat. Off.

The International Nickel Company, Inc.

67 WALL STREET **NEW YORK 5, N. Y.**

EMBLEM OF SERVICE
INCO
TRADE MARK

Many difficult problems of design and fabrication have been solved by HAYNES

PRECISION CASTINGS

1. **Quality Alloys** having an unusual combination of properties can be readily precision-cast. Parts cast from HAYNES STELLITE alloy, HASTELLOY alloy, and various stainless steels are now available.
2. **Small or Mass-Production Quantities** of shapes difficult to obtain by other methods of manufacture at reasonable prices can be produced by precision casting.
3. **Improved Designs** result because parts can be engineered for performance rather than convenience of fabrication.
4. **Interchangeability of Parts** is assured, because HAYNES precision castings are uniform in quality, size, contour, and finish.
5. **Intricate Shapes,** contours, and thin edges are consistently reproduced. Internal and external threads, shoulders, and cored holes can be produced.
6. **Improved Metallurgical Properties** and sound, dense castings mean long life of stressed parts operating at high temperatures.
7. **Smoother, Cleaner Surfaces** than those generally obtained by conventional casting methods are possible.

For more complete information, write for the booklet, "HAYNES Precision Castings."

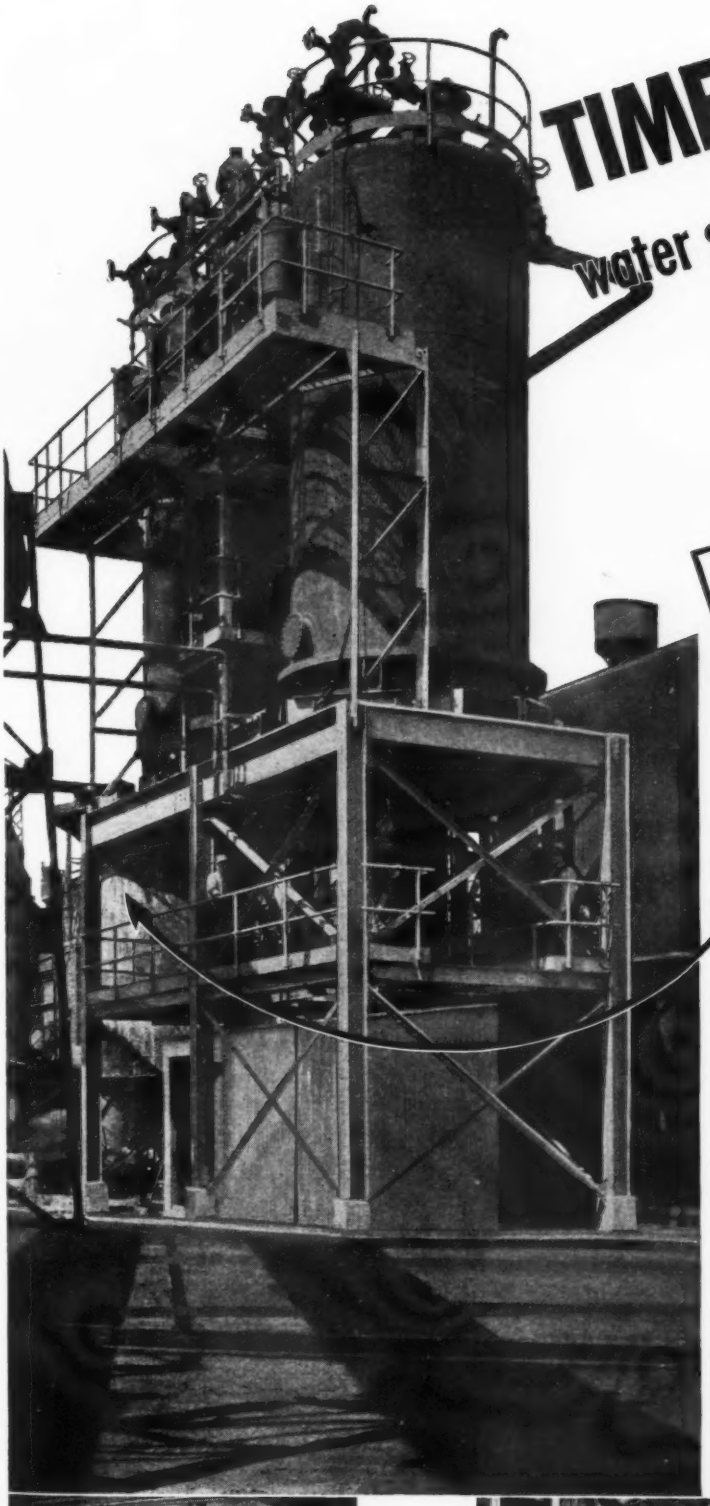
Here Are Some Samples of HAYNES Precision Castings in Use Today.

Haynes Stellite Company
Unit of Union Carbide and Carbon Corporation
UCC
General Offices and Works, Kokomo, Indiana
Chicago—Cleveland—Detroit—Houston—Los Angeles—New York—San Francisco—Tulsa

The registered trade-marks "Haynes," "Haynes Stellite," and "Hastelloy" distinguish products of Haynes Stellite Company.

HAYNES TRADE-MARK *alloys*

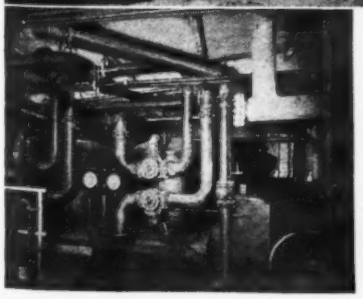
TIME (and improvement in water softening) MARCHES ON!



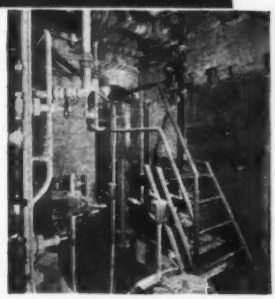
Original (1925) Softener

IN 1925, a Cochrane Hot Process Softener was installed in the Tilghman Street Gas Plant of the Philadelphia Electric Company at Chester, Pa. Now, 22 years later, this faithful old piece of equipment is being replaced by a new Cochrane Double Unit Hot Process Softener of 20,000 GPH capacity (10,000 GPH per unit). The double unit permits great flexibility of operation as one or both units may be used as desired. The needs of the plant have outgrown the capacity of the first unit which is largely the reason for the change, but the improvements in the process and the apparatus since 1925 are interesting in comparison with the old veteran. Welded construction replaces riveted, chemical proportioning and feeding are improved, automatic controls are featured and softening is accomplished with a speed and accuracy of result undreamed of in 1925.

COCHRANE
SINCE 1863



(Left) Two vertical pressure filters replacing existing conical filters shown in background



(Left) phosphate tank with motor driven agitator for mixing supplemental phosphate feed

(Left) Lime soda proportioners and mixing tanks

COCHRANE CORPORATION • 3106 N. 17th Street • PHILADELPHIA 32, PA.

Better VALVES

Better VALVES

LUNKENHEIMER BRONZE UNION

A new high point in low-cost valve service is yours in LUNKENHEIMER's new Figure 2228, 200 lb. Bronze Union Bonnet Gate Valve and companion valves. Combining traditional LUNKENHEIMER superiority in design, materials and workmanship, these valves have every feature you want for better service, longer life and lower overall cost.

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI 14, OHIO. U. S. A.

NEW YORK 13 CHICAGO 6
BOSTON 10 PHILADELPHIA 34

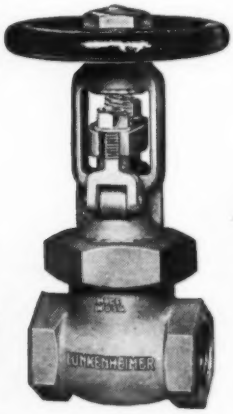
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK 13, N. Y.

Union Bonnet

Fig. 2228 Screw Ends
Fig. 2229 Flange Ends
Double Wedge Disc
Rising Stem

Union Bonnet

Fig. 2230 Screw Ends
Fig. 2231 Flange Ends
Wedge Disc
Non-Rising Stem



O. S. & Y.
Union Bonnet

Fig. 2232 Screw Ends
Fig. 2233 Flange Ends
Wedge Disc
Rising Stem

AS CLOSE AS YOUR PHONE...

... is your Lunkenheimer Distributor, with a stock planned to meet your requirements. His service is maintained for your convenience. Use it whenever you need valves, maintenance parts or advice on valve problems. The friendly assistance you get matches the better service given by LUNKENHEIMER VALVES.

BRONZE, IRON, STEEL, AND CORROSION RESISTANT ALLOY VALVES
AIR DEVICES, LUBRICATORS, AIRCRAFT FITTINGS

NEW 200 LB. BONNET GATE VALVE

NOTE THESE FEATURES

Malleable Iron Handwheel—Non-heat, easy, comfortable grip.

Rising Stem—Made of a distinctive silicon bronze alloy, developed and patented by Lunkenheimer. Remarkably wear-resistant, eliminates stem-thread failures. Exceptionally heavy stem head.

Hexagon Head Gland—Permits use of a wrench to loosen gland. Facilitates repacking.

Stuffing Box—Large and deep. Long thread provides solid engagement with packing nut to form a tight joint when fully packed.

Repacking Seats—Repackable under pressure when wide open. Repacking seats above stem thread, perfectly machined.

Bonnet—Union bonnet 2 in. and smaller; bolted bonnet 2½ in. and 3 in. Both provide a strong, tight joint; easily disassembled.

Body—Made of high grade bronze which meets the A.S.T.M. Specification B-61. Heavy, rugged proportions and straight through full flow areas.

Double-Wedge Disc—Nickel alloy, ball and socket bearing; no internal wedge or pin. Discs readily adjust themselves to taper seats, insuring a tight valve.

Stay-On Discs—Will not drop off stem when assembling valve. Bevelled disc wing guides and body channels make assembly easy.

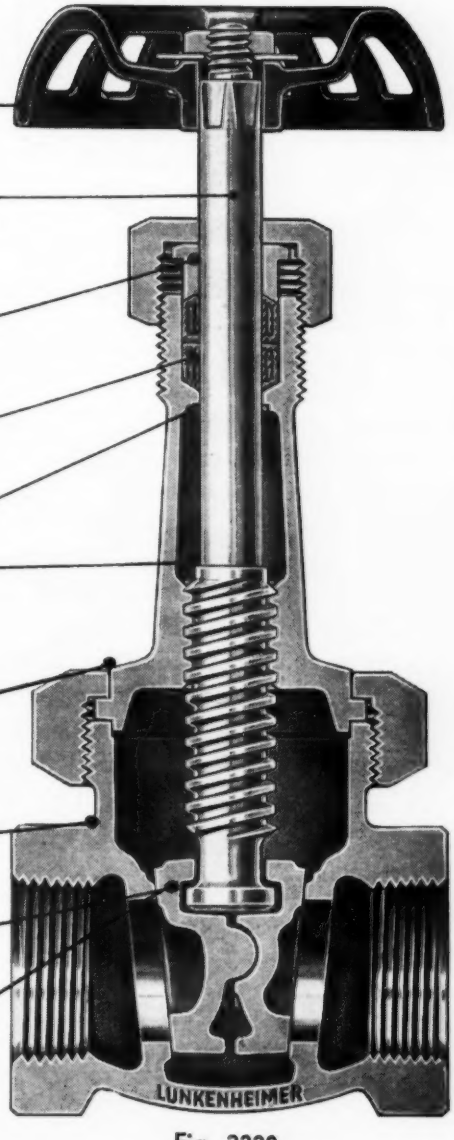


Fig. 2228

LUNKENHEIMER VALVES

Which water

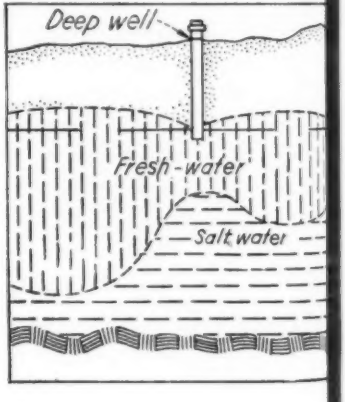
WATERS from different sources may be identical or radically different in appearance—but you can't tell by looking at them which source to choose for your plant.

Even the most thorough chemical analysis seldom provides more than a starting point for the study on which a decision must be based.

Along the Gulf Coast, for example, there is an area where river water contains much suspended matter and is otherwise contaminated, while well water is clear and of excellent quality. The well water is obviously preferable—but industries take a chance in using it, for salt water underlies the fresh water table, and any large use of fresh water may cut down the pressure, let the salt water in, and spoil the whole supply.

To plants near the sea coast, salt water is often a serious problem, even when they get their water supply from rivers. Tidal flow may cause brakish water many miles from the river's mouth, particularly in periods of dry weather. The Delaware River offers a marked example of this tendency. A Canadian plant has even gone to the length of damming a river below the raw water intake in order to keep sea water out.

Variability of water sources is always a problem. One Louisiana plant, for example, had a choice between river water which was right "at the door," and water from an artificial lake nearly two miles away. Comparison of water samples showed that both waters would require coagulation, filtering, and softening. The lake water was better in quality, but there was the cost of a two-mile pipe line to be considered.



When samples of the two waters taken at various times of the year were studied, the decision was easy. At high water, the

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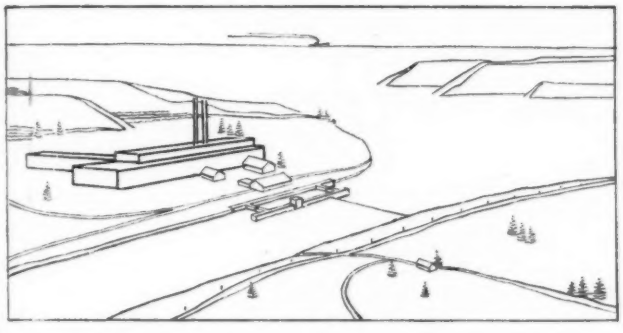
is best for your plant?

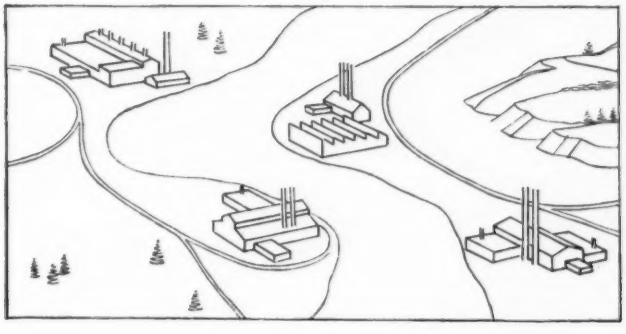


river became extremely muddy; at low water, organic contamination was great and there was even contamination by salt from wells drilled for oil at various points along the river. The lake water, however, was very even in quality, virtually the only change being a somewhat greater amount of suspended solids after heavy rains.

Contamination by industrial wastes from other plants may also be a serious problem, and this, too, may become more serious when water flow is low. In some instances, both the cost of treating contaminated waters and the cost of using alternative sources have been so high as to force a change in the choice of plant site.

These are only a few of the problems that may arise in selecting a water source. Water quality cannot be neglected—*water quality at all times, under all conditions and, as far as it can be foreseen, for the life of your plant.*

In the matter of water sources, as in all other industrial water problems, Hall Laboratories is prepared to recommend procedures which, taking all factors into account, represent the most economic and efficient solution *in your specific situation.*



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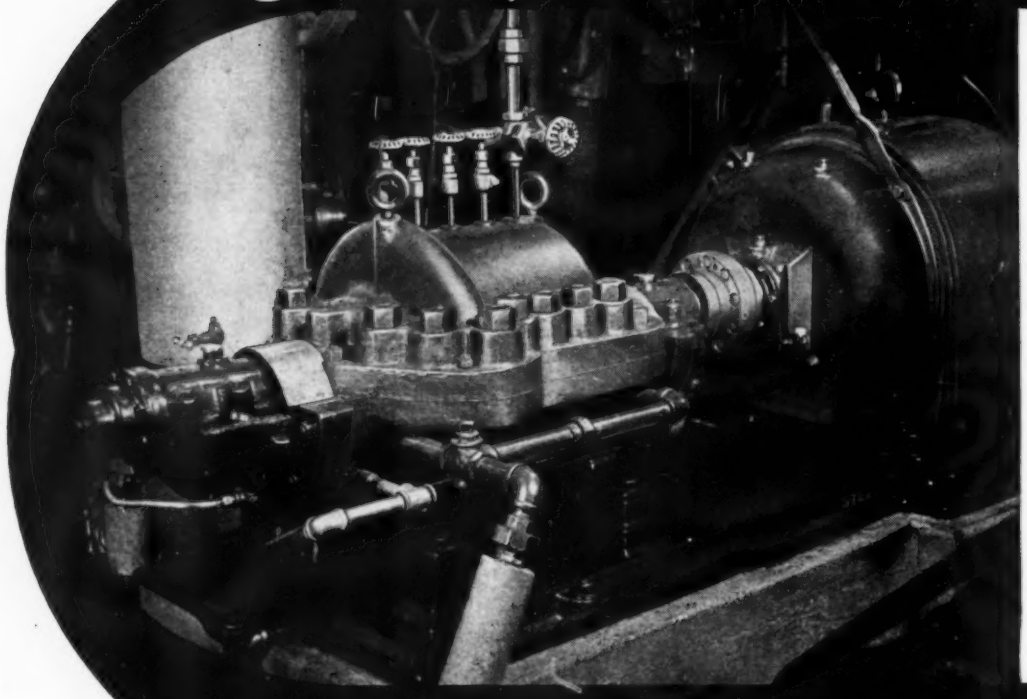

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JANUARY 1948 VOLUME 92, NUMBER 1

A CROSS-INDEX OF SUBJECTS FOR THE MONTH

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TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
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TRANSMISSION, LUBRICATION
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Cover photo: Steel-mill power distribution controlled by Westinghouse 6600-volt metalclad air-break switchgear

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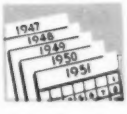

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In the course of a plant overhaul, a Pennsylvania engineer tore down an old ammonia condenser, installed just after the turn of the century.

The pipe was encrusted with sediment on the outside and to the casual glance seemed to be reaching the "end of its string." But careful inspection and testing told a different story . . . as the illustrations show.

The outside after cleaning showed a characteristic roughened surface, but was completely free of any deep local pits. Threads were still sharp and clean. A specimen was split in two and the inside was quite smooth. After cleaning it was very clear that almost no corrosion had occurred and the interior was in splendid condition.

It is probably unnecessary to say that the replacement piping selected by the engineer was Byers Wrought Iron.

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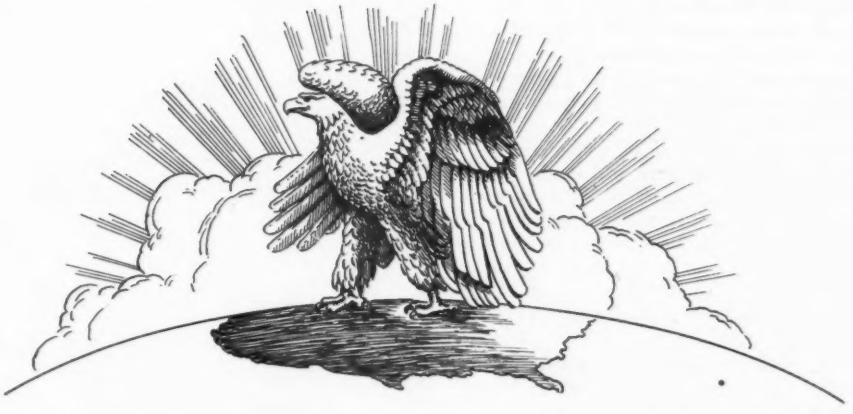

THE STRENGTH OF AMERICA

Once in a while it is necessary for men and nations to stand aside from the daily turmoil and look critically at the standards by which they live. In his address before the third session of the Herald-Tribune Forum, David Lilienthal, chairman of the U. S. Atomic Energy Commission, has done just this for the United States. We are proud to reprint, for power men, his glowing testament to our American faith.

GENERALLY SPEAKING, it's not a good idea for an individual to think too much about himself. He can become so occupied with how his digestion is getting along that just fussing about it will get it out of fix. Perfectly healthy people can give themselves the jitters by paying too much attention to their nerves and their mental processes. The advice "Let your mind alone" has a lot to be said for it.

I have a feeling that much the same thing applies to nations, and particularly to a nation as healthy and high-spirited as the United States of America. But a certain amount of national self-examination is inescapable, and indeed, at this juncture in world events it is not only inevitable but wholesome. The eyes of the world's people are upon us these days. Everything we do (and a good many things we don't do) and much of what we say, in this wonderfully talkative and uninhibited land of ours, occupy the attention of hundreds of millions of people in England, in France and the Lowlands, in Italy and the Balkans, in Latin America, in the vast reaches of Soviet Russia. So that even though we might prefer not to talk about our own health, about what it is that makes us so fit, or about that occasional headache, the times just won't permit.

U. S. IN THE SPOTLIGHT

Each day all over the world, we, the people of the United States, are given a physical and mental appraisal by the people of other lands. Some of this "going over" is so palpably false, so coarse and downright mean that it shocks most of us; for very few of us are given to such extremely bad manners when we talk about other peoples.

But whether the looking over we are getting around the world is sincere and temperate—as it often is—or deliberately false, and incredibly mean—as much of it is—the justification for this constant appraisal of America is clear enough. For we no longer say, "Our way is good enough for us; please go away and don't bother us with your problems." Upon a world-wide stage we stand today as the exemplars and the active protagonists of certain heroic principles of human life, about which we feel so deeply that we are prepared to stake everything upon keeping them alive and flourishing. We assert that the principles by which we live are basically opposed to and demonstrably superior to those modern versions of tyranny over men that first enslaved and then destroyed the German and the Japanese people and that now threaten the peoples of all Europe and of Asia.

If I understood the essence of our evolving foreign policy, it is based largely upon what we believe to be the peculiar merits and the superior qualities of our domestic policy, that is, our way of living together here at home. The anxious peoples of the world are bedeviled and often confused by many voices in their

LILIENTHAL—Maker of Atomic Policy

DAVID LILIENTHAL holds one of the world's big jobs. As chairman of the U. S. Atomic Energy Commission he guides nuclear research and development in the nation where greatest strides have been made. With his four associates he directs an atomic empire—Oak Ridge, Hanford, Los Alamos, the new national laboratories such as Argonne and Brookhaven, and the many smaller projects in industry and educational centers. It is an empire with a budget of a million dollars a day.

He comes to the task with a record of action and a philosophy that have earned the respect and confidence of his fellow Americans. As policy chief of TVA at its inception in 1933, he was prime target for criticism of the venture. In 13 years with TVA, he survived congressional investigation and bitter opposition to make the Authority best known of New Deal inventions. In so doing he won the personal admiration of many determinedly opposed to TVA.

With Acting Secretary of State Dean Acheson he wrote the report that made U. S. policy on atomic energy. He stands for international control of all the crucial phases of atomic energy. Until such control is realized, he wants America to lead in nuclear research. He knows that this means making more atomic bombs and accepts the implications. Keenly aware of the profound significance of nuclear research to world peace and the future well-being of the world's peoples, he is yet sufficiently realistic to know that the road is long and strewn with many obstacles and pitfalls.

own lands, telling them just what America is like, what our motives are. The confusion abroad is natural enough. But we should take care that we ourselves do not get confused about the sources of our strength, about what it is that makes America strong and that will keep her strong.

What is this source and this foundation of our American strength? The answer most commonly heard is: Our economic system. This "system" is variously referred to as the capitalist system, or democratic capitalism, or the system of free enterprise, or some similar expression.

THE BASIS OF STRENGTH

The central role of free, competitive, private enterprise can hardly be exaggerated. But neither this nor any other answer in economic terms can explain our basic vitality.

The basic source of the strength of American civilization does not lie in an "economic system." The well-springs of our vitality are not economic. They go deeper still; they are ethical and spiritual. Our society in America is founded not upon the cold and bloodless "economic man" of the Marxist, but upon a faith in man as an end in himself. We believe in man. We believe in men not merely as production units, but as the children of God. We believe that the purpose of our society is not primarily to assure the "safety of the state," but to safeguard human dignity and the freedom of the individual. We are a people who have built upon a faith in the spirit of man, who conceive that the development and happiness of the individual is the purpose and goal of American life. I judge that we are not ready to "trade in" this luminous concept of a people's purpose for the notion that the America of the Bill of Rights, of Walt Whitman and Justice Holmes and Abraham Lincoln, is simply a highly productive economic system.

What we have, actually, is not a system at all, but almost its opposite, that is, a society of the greatest imaginable diversity, and flexibility, taking things as they come, deciding how to handle situations by the facts of each situation itself—"doing what comes naturally."

"SYSTEM" IS THE RESULT

What I have said may start an argument, but it will not be merely an argument over the meaning of words. I speak of the substance of things. I am asserting that the vitality of our distinctive institutions of production and distribution of goods ultimately depends not upon rigid and fixed economic principles but upon ethical and moral assumptions and purposes; that our unparalleled productivity and standard of living are not the consequence of an economic system, but rather the other way around; that our economic success and our flourishing economic institutions are the consequence of our ethical and moral standards and precepts, of our democratic faith in man.

We have ethical guide lines in this country. We have developed rather highly a sense of what is right and what is wrong, of what is fair and decent, and what is just crude use of arbitrary power. A cynical labor leader or business giant, a cynical politician or public official—those who conceive of American society as nothing more than a jungle in which the most ruthless prevails—we may not catch onto such men right away. We can be fooled for a time by a mask of pretense. Sometimes we are slow to repudiate cynical disregard of our democratic faith —but that faith is always there, the foundation of our buying and selling, our hiring and firing, our political and financial institutions. No factory can be operated, not a carload of wheat

AMERICA'S STRENGTH—THE ESSENCE

"Upon a world-wide stage we stand today as the exemplars and the active protagonists of certain heroic principles of human life, about which we feel so deeply that we are prepared to stake everything upon keeping them alive and flourishing.

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"Some would have us believe that because we excel in making millions of the same kind of useful gadgets that therefore we are free men. No, that has the cart before the horse. It is because freedom for men is a primary ethical concern of ours that we do so well in making gadgets and raising food and doing successfully many other things—among them the winning of wars.

"We ourselves should be very clear about American fundamentals as we move into the most fateful role we have ever played in world affairs. For our leadership in large part depends upon our continued capacity to demonstrate how superior, in human terms, is our way of living. If I am right in what I have been saying, then it is important—desperately important—that we be clear in our own minds about the true sources of our strength; that we nourish and safeguard the ethical principles that make us strong."

sold, not a labor dispute negotiated, not an election held, that these ethical, legally unenforceable precepts are not part of the transaction.

I do not see how our kind of society could flourish in any other way. A highly interdependent country, one capable of producing more than $150,000,000,000 worth of goods a year, is too complex for rigid planning and the enforcement of detailed plans by law. We must function in a loose, informal way under sanctions that are largely ethical and moral, based upon commonly accepted standards of fair play and respect for human integrity. This is the way we do function, by and large, and this is why we flourish.

Some would have us believe because we excel in making millions of the same kind of useful gadgets that therefore we are free men. No, that has the cart before the horse. It is because freedom for men is a primary ethical concern of ours that we do so well in making gadgets and raising food and doing successfully many other things—among them the winning of wars.

Diversity and flexibility, rather than a stereotyped hard-and-fast system, is an essential part of such a noble concept of society as is ours. We get our economic services in the way that at the time seems to work best, that will in a particular situation best advance our underlying purposes. We do not start with all the answers, the economic or political answers. We make the answers up as we go along. Thus American industry is owned and operated, by and large, by competitive private enterprise; yet a year ago the Senate of the United States voted unanimously to establish public ownership and management in one of our largest industries and make it a government monopoly—I refer, of course, to the atomic-materials industry. That appeared to be the thing to do at the time, for reasons related to the facts of atomic energy, not for ideological reasons taken out of some book of economic dogma.

AMERICAN DIVERSITY

The most rock-ribbed Midwestern town I know has for many years owned and operated its own electric power and light plant. Is this, then, a "Socialist" town? Hardly! Its water service has been privately owned for the same period. There is a privately owned university, a public junior college. No one considers that these things are inconsistent; and, of course, they are not, except to the dogmatist who thinks we have a fixed "system." In the same town there is a farmers' feed co-operative that is not quite private or quite public, operating side by side with a big privately owned feed company. There are private banks, there are non-profit insurance companies, there are state-owned liquor stores. We would never consider adopting government ownership or control of newspapers partly because of their educational character; but our school system, the cornerstone of American education, is almost entirely publicly owned and managed. This is all part of the familiar picture of American diversity, of American flexibility.

The fact is that we have hardly an ounce of economic dogmatism in us. This characteristic diversity of ours, this capacity to adapt ourselves to any need stands us—and the world—in good stead tonight. For in western Europe there are many different kinds of economic undertakings and methods of controls; and, as befits world leaders, we are peculiarly equipped by reason of our own economic versatility to deal effectively with each of these, without sacrifice of our own unifying sense of purpose and direction.

PROBLEM OF LEADERSHIP

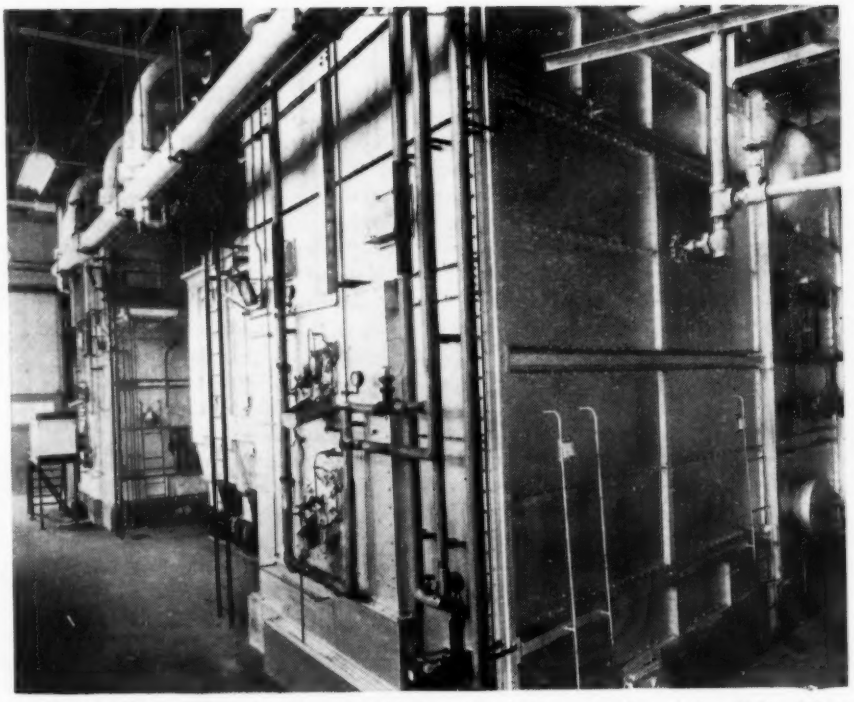
We ourselves should be very clear about American fundamentals as we move into the most fateful role we have ever played in world affairs. For our leadership in large part depends upon our continued capacity to demonstrate how superior, in human terms, is our way of living. If I am right in what I have been saying, then it is important—desperately important—that we be clear in our own minds about the true sources of our strength; that we nourish and safeguard the ethical principles that make us strong.

Now no candid person—no honest person—would deny that there are today some disturbing tendencies in our country away from this concern for the individual, away from our standards of fairness between men. We are witnessing in some quarters as ugly a scene of hoggishness and money mania as we have seen since the days of the '20s. Many of those who spent the years of their youth fighting for this country returned to find themselves the victims of legal crookedness and outrageous speculation. These and other evidences of disregard for our ethical precepts do exist in some quarters; and to the extent that they exist they poison the wells of our material as well as our spiritual strength.

New Boiler-Plant Design Features

Oil-fired plant, built on site of coal-fired one without interrupting process service, gives needed capacity, reduces steam costs. Adequate meters and automatic combustion control permit plant engineers to obtain practical boiler-test performance every day

By JAMES A KEARNS
Consulting Engineer, Montreal, Canada



NEW BOILER PLANT has two 30,000-lb-per-hr boilers, designed for 200 psi but operated at 125 psi and 425 F total temperature. One old coal-fired boiler, shown between the two new ones, was retained for operation in emergencies

► FOR OVER 50 YEARS Melchers Distilleries has been at Berthierville, on the St. Lawrence River about 50 miles from Montreal. The plant has been modernized several times to maintain high standards of efficiency and the quality of its products—high-grade Scotch and rye whiskies, London and Geneva gins, industrial and potable alcohols from both grain and molasses. Latest improvement is complete modernization of the boiler plant, something that could not be done until now because of war restrictions.

During the war, as in all Canadian distilleries, total production capacity was devoted to manufacture of industrial alcohol for synthetic rubber and chemicals. The return of peace found the steam plant practically worn out. Aged equipment had been forced continuously for maximum production, and maintenance had been inadequate because of the difficulty of holding experienced operators and making necessary repairs and replacements. Accordingly, the company launched a modernization program, and retained the writer as consulting engineer to design and supervise the construction of a new boiler plant.

Steam Demands. A distillery requires large quantities of medium- and low-pressure steam for still operations, grain cooking, regulating mash-vat temperatures and drying spent grain, the latter marketed for farm-stock feed. In winter, steam demands for building heating are heavy because for long periods outside temperature remains around zero, and at times drops to 30 F below, or lower.

Steam demands for certain distillery processes fluctuate widely. Grain cookers and some stills operate on live steam with requirements that may suddenly vary as much as 50%. Other stills call for continuous operation and uninterrupted steam supply.

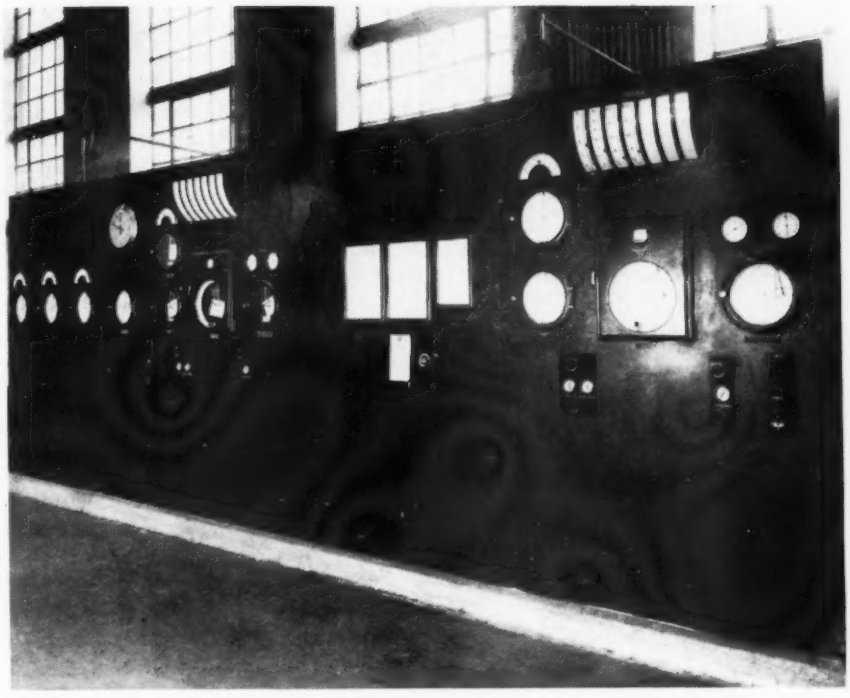
The stills require large quantities of cooling water, which is pumped from the river. Because of difference in water temperature about three times as much water is required for the same production in summer as in winter. For this reason, as much annual production as possible is scheduled for the fall, winter and spring months. General plant overhaul and vacations take place in the summer, a period of light operations.

Taking consideration of these and other factors led to a boiler plant design that would have high efficiency and reliability, and be simple to operate. The fact that this distillery is the only one operated by the company further enhances the importance of reliable continuous operation. Lost production cannot be supplied by another plant, as with companies operating several plants.

New Units Oil-Fired. Either high-grade coal or fuel oil could have been selected for firing the new boilers, but even though the old boilers were coal fired, oil was chosen for several reasons. It is as economical a fuel as coal at the plant location. It eliminates coal dust around production departments where cleanliness is a prime consideration. Either coal or oil can be received by railway, but oil is much easier to store and handle than coal, particularly in winter during periods of heavy snows and subzero temperatures. Handling and storing oil requires much less effort than coal does, an important consideration under present conditions. An oil-fired plant is simpler in design and operation, and avoids the large fuel storage required by coal. Oil firing is well adapted to handling the widely fluctuating process and heating steam demands.

Steam - Pressure Selection. Power, process-and-heating steam for the plant could have been supplied by installing

Reliability and Simple Operation



INDICATING AND RECORDING METERS: A full complement of these instruments has been provided for the boilers. They are also equipped with automatic control to maintain high operating efficiency over wide range of steaming load

high-pressure boilers and backpressure bleeder turbines. But these units require a considerably larger investment in equipment, a much more complicated plant to operate, and a more highly skilled operating staff than a simple boiler plant. The management wanted to avoid these responsibilities because there were no compensating factors here that would make them worth-while.

Power, which can be purchased from the local utility at low rates, is supplied from a large hydroelectric system. Thus these rates can be expected to remain fairly constant no matter what may happen to fuel costs. Therefore provisions were not made in the new boiler-plant design for future power generation. This led to selecting boilers to provide steam at a pressure and temperature required for process and heating only.

A New Building. It was desirable to build the new boiler plant on the site of the old one, which contained three watertube boilers of 2500 sq ft and one hrt of 1400 sq ft of heating surface, all hand fired. Immediate and future steam demands indicated that the new boiler capacity should be about double that of the old in two new units with provision for a third when required.

A greatly enlarged plant had to be built on the site of the old one without interfering with distillery operations. The first step in this program was to construct around the old plant a new building, designed by Architect Charles David, of suitable size to house three new boilers, and their auxiliaries and control equpment (plan at top of p. 68). With completion of the new building, the old boilerhouse was removed to permit installation of the new boilers. Construction of the new plant was considerably simplified by not having to provide a coal bunker and other storage facilities.

The plant was so located that when one old hrt boiler was removed space was available for the first new one. When this unit, as well as a new stack for three boilers, was erected and in operation it was cut into service; then the two old watertube boilers in the opposite end of the plant were removed and the second new boiler installed.

Photo on p 66 shows the interior of the new boiler plant where the one remaining old boiler can be seen with a ladder in front of it. This unit has been retained in standby service for coal firing if, because of a strike or other cause, the fuel-oil supply should fail temporarily. Future plant expansion includes installation of a third boiler between the two new ones where there will be ample space when the old one is removed. The new plant was designed with this expansion in view, which would provide a peak steaming capacity of 100,000 lb per hr.

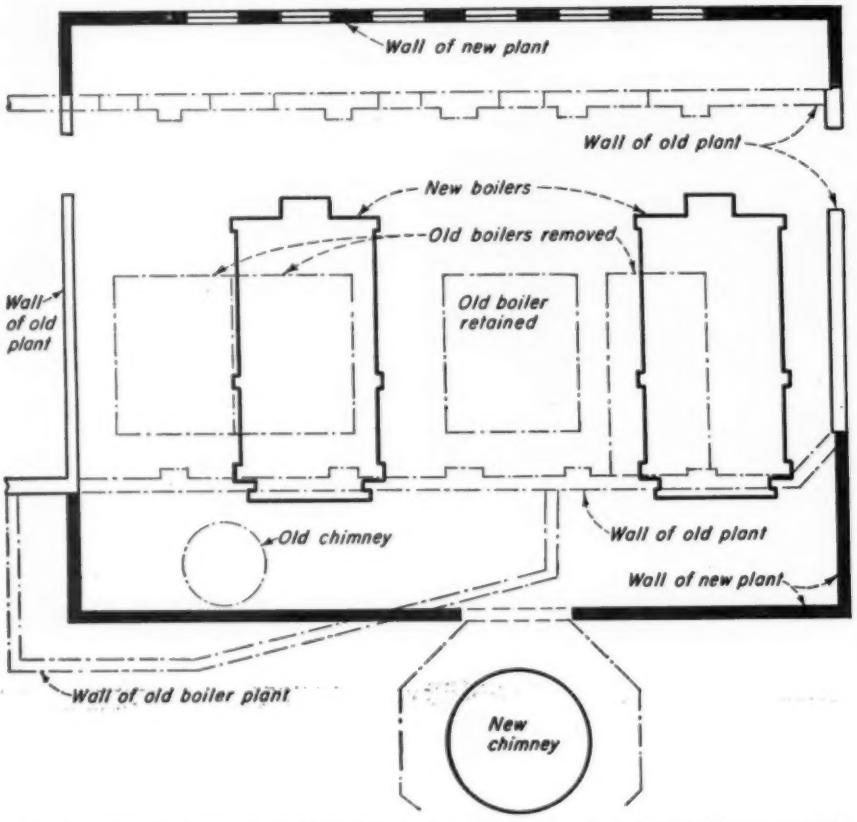
Two New Boilers. Designed for 200 psi, each of the new units with waterwall and slag-screen furnaces, has a continuous steaming capacity of 30,000 lb per hr and will operate at 125 psi and 50- to 75-F superheat, a total temperature of 400 to 425 F. Each unit has a maximum 2-hr steaming rate of 35,000 lb per hr. To meet requirements for a boiler and furnace efficiency of over 84%, tubular air heaters were provided, designed to heat the combustion air from 80 to about 300 F.

Boiler Auxiliaries. To simplify plant design and operation induced-draft fans were omitted and draft provided by a forced-draft fan on each boiler and a 175-ft stack that serves the two. To compensate for the absence of induced-draft fans and to obtain high efficiency the boilers have been designed for low draft losses by keeping the gas velocities comparatively low through them.

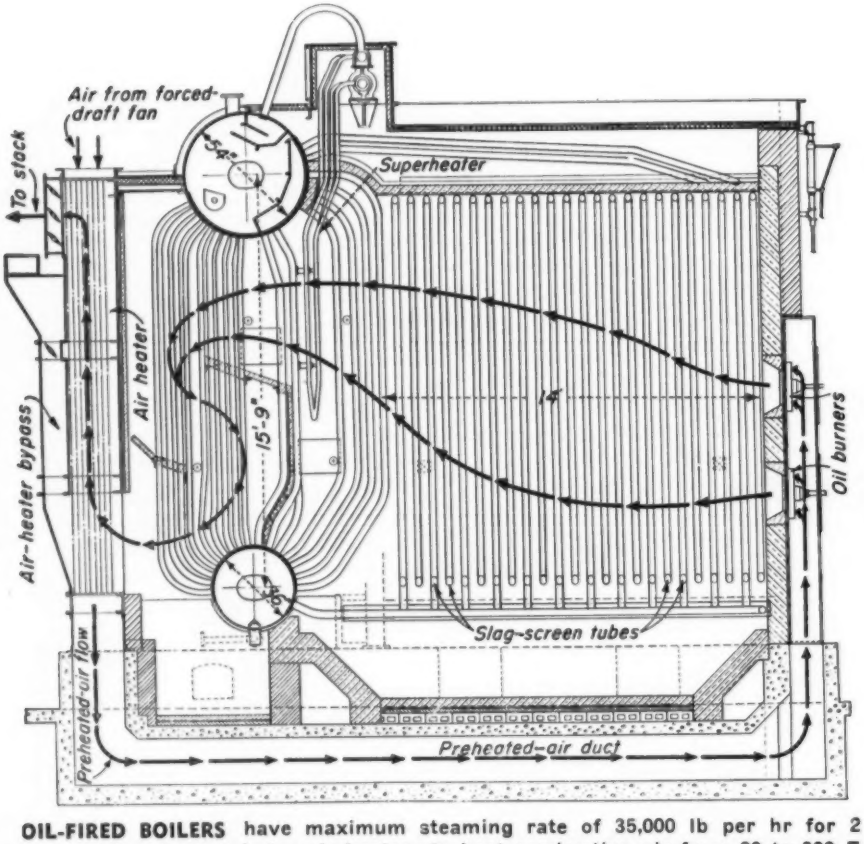
Natural draft was favored by maximum steam demands coinciding with the higher stack draft available in winter when outside temperatures are lowest. With 80-F outside temperatures, stack draft is ample to maintain a furnace pressure of −0.1 in. of water when generating 25,000 lb of steam per hour. In summer should the boiler have to operate temporarily at a higher steaming rate, a damper permits bypassing part of the gas around the air heater with a slight reduction in efficiency (see bottom of p 68). During winter outside temperature is such that draft is ample under all load conditions without bypassing the air heater.

Two forced-draft variable-capacity mechanical atomization burners, one above the other in the furnace front, fires each boiler with bunker-C fuel oil. At present oil is an economical fuel for many applications in this part of the Province of Quebec but in the future the price differential may favor high-

NEW PLANT SUPERIMPOSED ON OLD ONE



PLANS FOR THE NEW PLANT: First step was to erect a new building around the old one, suitable to house three new boilers and their auxiliary equipment



OIL-FIRED BOILERS have maximum steaming rate of 35,000 lb per hr for 2 hours. They have tubular air heaters to heat combustion air from 80 to 300 F

grade coal. Provisions have therefore been made in the windbox and furnace design so the fuel can be readily changed to pulverized-coal firing if it becomes desirable.

The furnace has been equipped with a slag screen and made large enough to keep the heat release below 22,500 Btu per cu ft per hr at peak load. Ash doors are large; provision is made for an ash conveyor and its intakes in the boiler-room floor. If fuel is changed, the lower burners will be removed and their holes in the furnace wall bricked up. A forced-draft pulverized-coal burner will replace the upper oil burner.

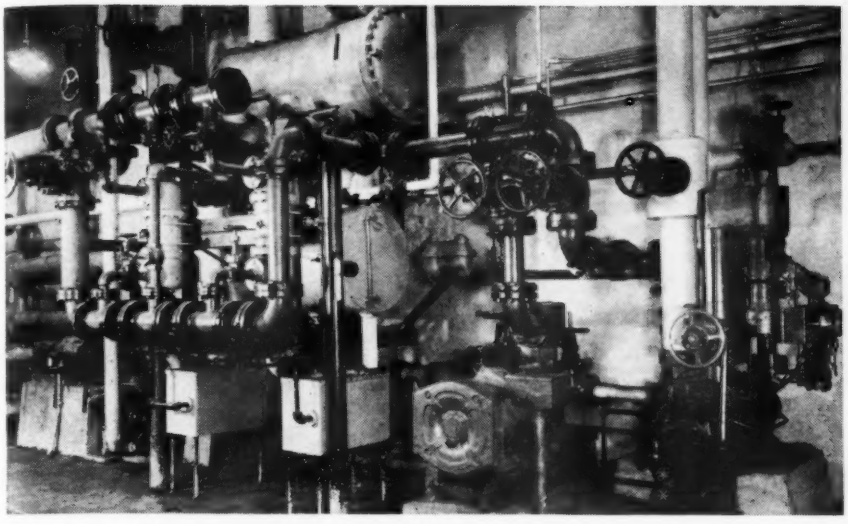
Fuel Oil. Oil is received by tank car and pumped to three 28,000-gal tanks near the boiler plant. These tanks are heat insulated and encased in sheet aluminum to retain as much heat as possible in the oil. Oil and steam lines from the boiler room to the tanks are installed in wooden runways filled with insulation and incased with sheet metal so that the steam line acts as a heater for the oil lines. Provision is made at the storage tanks for steam-heating them and the tank cars.

Two tank cars can be spotted on the siding. Oil is pumped from these to any one of the three storage tanks. In addition, piping is arranged to permit pumping oil from any tank to the oil heaters in the boiler plant or from any one tank into another. The latter provision takes care of an emergency such as would arise if a tank started to leak.

Uninterrupted Steam Supply. As previously mentioned, distilling processes are continuous operations that, once started, should not be interrupted. Therefore in the boiler-plant design everything economically possible has been done to insure an uninterrupted steam supply. The boilers connect to a loop steam header valved in such a way that either boiler can be used to feed the process and heating lines should either header section be out of use.

Practically all auxiliaries are in duplicate, one motor and one steam driven. Oil unloading and transfer pumps include a steam-driven direct-acting and a motor-driven rotary. Heaters and burner pumps are provided in a similar combination. For boiler feed, steam-turbine and motor-driven centrifugal pumps are installed (see photo, p 69). An exception to duplication of equipment is the forced-draft fan, which is motor driven, on each boiler. If the fan's drive should fail the air heater can be bypassed to keep the boiler going until the other unit is brought into service.

There is always the possibility of a



BOILER FEEDWATER EQUIPMENT includes two feedwater pumps, one motor- and one steam-turbine-driven. Each unit is rated 70,000 lb per hour at 175 psi

failure of power to the plant, which is being provided for by the installation of an emergency internal-combustion engine-driven generator unit. This will take care of essential power needs among them the forced-draft fan motors.

Boiler Instruments. Fuel costs are comparatively high for either coal or oil; therefore it is essential that plant efficiency be maintained at a high level. To this end the boilers have been provided with a full complement of indicating and recording meters and equipped with automatic combustion control (photo on p 67).

With these meters the operator has practically complete knowledge of boiler and auxiliary performance without leaving the control board. Then by the aid of the automatic-control equipment he can obtain from the boilers practical test performance in everyday operation. In this installation, such performance is an average boiler and furnace efficiency of 84%. In addition, the new plant provides much needed boiler capacity and improved boiler-plant efficiency of about 40%.

The author expresses his thanks to F W Roffey, secretary, and H J Senk, plant manager, Melchers Distilleries Ltd, and their staff, for cooperation and assistance in carrying out the work of modernizing the company's boiler plant and in preparation of this article.

PRINCIPAL STEAM AND ELECTRICAL EQUIPMENT

Boiler Plant of Melchers Distilleries

STEAM-GENERATING EQUIPMENT:

Boilers and air heaters.....Dominion Bridge Co
Boilers; 2 drum, bent tube; integral furnace; 5000 sq ft of heating surface in boiler and waterwalls; rated continuous steaming capacity 30,000 lb per hr; maximum 2-hr steaming capacity, 35,000 lb per hr; 200-psi drum-design pressure, 125-psi operating pressure at superheater outlet; 425 F, total steam temperature; 2100 cu ft furnace volume; 22,500 Btu maximum heat release per cu ft per hr.
Superheaters .....Superheater Co Ltd
Boiler-supporting steel, casings, ducts and breechings
Dominion Bridge Co
Boiler refractories .....Canadian Firebrick Co
Boiler heat insulation.....Asbestos Ltd
Boiler refractories and insulation installed by .....Atwood Ltd
Soot blowers, air puff.....Diamond Specialty Ltd
Chimney .....Francis Hankin & Co
Radial, brick, 175 ft above boiler-room floor, 78 in. inside diameter at top, lined for lower 50 ft.

FEEDWATER SYSTEM:

Feedwater chemist .....Milton Hersey Co
Feedwater heater .....Darling Bros
Whitlock, 6-pass horizontal, 195-sq-ft heating surface
Feedwater regulators (Copes).....Peacock Bros
Continuous blowdown .....Permutit Co of Canada
Nonflash, heat exchanger and orifice rate-of-flow control
Water columns with Klinger reflex water-level gage
Dominion Bridge Co
Feed pumps, 2 (Weir).....Peacock Bros
One turbine-driven, one motor-driven, 70,000 lb per hr, 175 psi.
Feed-pump turbine, 5600 rpm; steam condition 125 psi, 425 F, 5-psi back-pressure.
Feed-pump motor.....Lancaster Motor & Dynamo Co
Squirrel-cage, 32 hp, 440 v, 3550 rpm with automatic device to cut in turbine driven pump if electric power fails.

METERS:

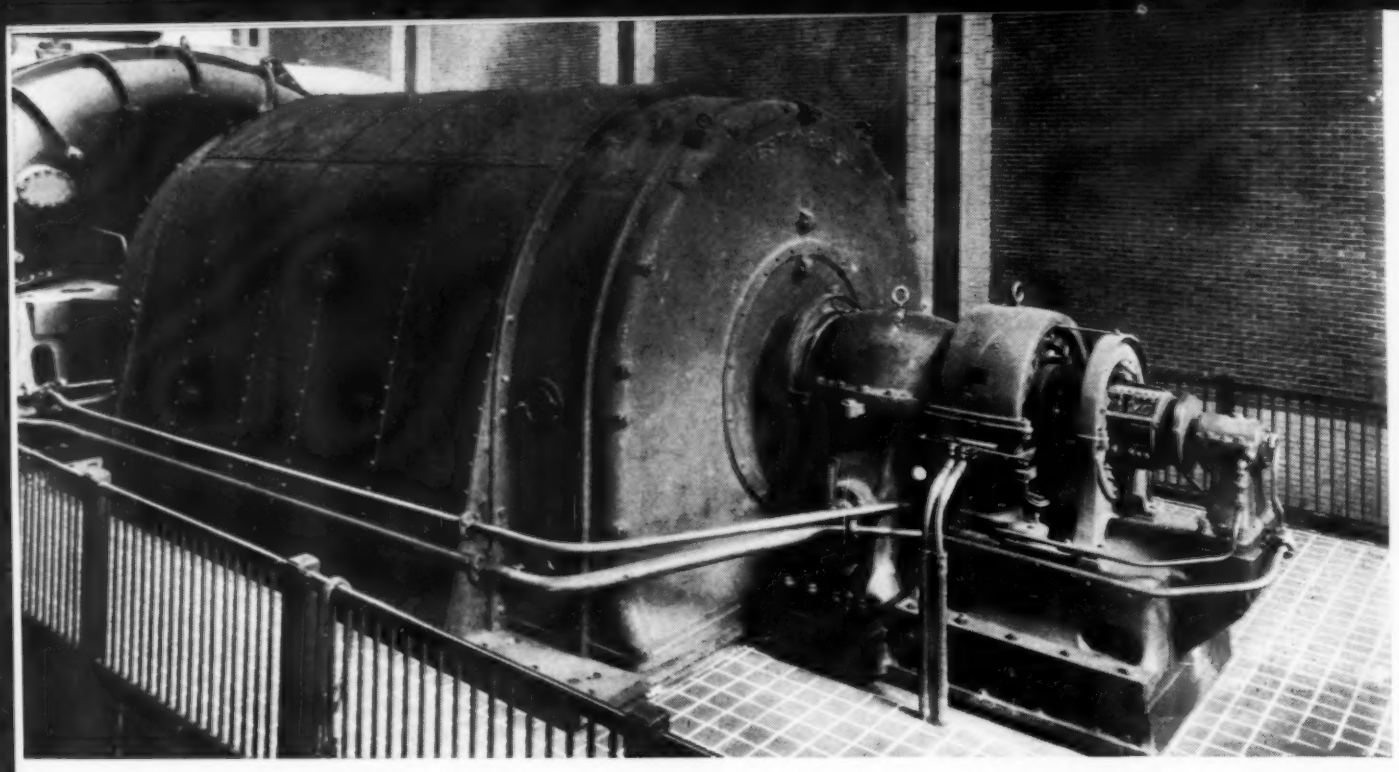
Steam-flow air-flow meters, steam-temperature recorders, draft gages (7 point), CO_2 indicators and recorders, steam-pressure and temperature recorders, and feedwater-temperature recorders
Republic Flow Meters Co
Boiler water-level and oil-storage-tank liquid-level recorders
Republic Flow Meters Co
Oil-pressure gages .....Manning, Maxwell & Moore
Thermometers .....Manning, Maxwell & Moore

COMBUSTION EQUIPMENT:

Automatic combustion control (Hagan Corp)
Dominion Flow Meter Co
Air Compressor, 18 cfm, 100 psi.....Ingersoll-Rand Co
Oil burners, 2 per boiler (Todd)..Combustion Engineering Corp, Ltd
Windboxes and ducts.....Henderson Barwick Co
Oil heaters, 2 (Paracoil).....Davis Engineering Corp
Electric heater, 6 kw (Todd).....Combustion Engineering Corp, Ltd
Oil pump, direct-acting, steam.....Dean Bros Co
Oil pump, rotary, motor driven.....De Laval Steam Turbine Co
Oil steam-pump governor.....Leslie Co
Oil pressure constant-relief valve.....A. W. Cash Co
Relief valves .....Crosby Steam Gage & Valve Co
Oil-temperature regulator .....Spense Engineering Co
Suction and discharge oil strainers (Todd)
Combustion Engineering Corp, Ltd
Oil-storage tanks, three, 28,000 gal, each.....Toronto Iron Works
Oil-storage-tank heat insulation.....Asbestos Ltd
Oil-transfer pump, direct-acting, steam.....Dean Bros Co
Oil-transfer pump, motor driven.....Viking Pump Co
Oil-transfer-pump motor, 5 hp.....Canadian General Electric Co
Forced-draft fans, vane control.....Canadian Blower & Forge Co
Motor driven, 10,000 cfm at 7 in. wg and 100 F.
Force-draft-fan motors, 15-hp, squirrel-cage
English Electric Co of Canada
Fan-motor starters, across the line.....Canadian Controllers

VALVES, PIPING AND TRAPS:

Piping contractor .....The Garth Co
Safety valves (Consolidated).....Manning, Maxwell & Moore
Nonreturn, blowdown and feedwater stop valves.....Hopkinson, Ltd
Main stop valves at boilers.....Hopkinson, Ltd
Steam-line gate and globe valves.....Crane Co
Feedwater-line valves .....Jenkins Bros
Oil-line gate and globe valves.....Crane Co
Pressure-reducing valves .....Mason-Neilan Regulator Co
Traps .....Armstrong Machine Works
Expansion joints .....Yarnall-Waring Co
Piping insulation .....Eaman-Riggs, Ltd
Plant construction and chimney foundation..Bremner Constr Co, Ltd



EARLY MAIN AND PILOT EXCITERS on turbine-generator sets were generally conventional dc machines adapted to fit the job. This photograph shows a 3600-rpm machine installed about the time of the first world war

Turbine-Generator Exciters Keep

High-speed exciters are no longer a standard dc machine connected to the turbine-generator shaft. They give increased service, run as long as the main generator without shutdown

By C LYNN, *Manager, Dc Engineering Dept, Westinghouse Elec Corp*

► SHAFT-DRIVEN EXCITERS provide the commonest method of furnishing excitation for turbine-generators. The reason for their wide use is reliability of drive, and unity of construction and operation of turbine, generator and exciter. Any other source of excitation is subject to failure of the drive or other units introduced into the system. The one disadvantage of shaft-driven exciters is that the turbine-generator must be shut down, in case of trouble, to work on or remove the exciter.

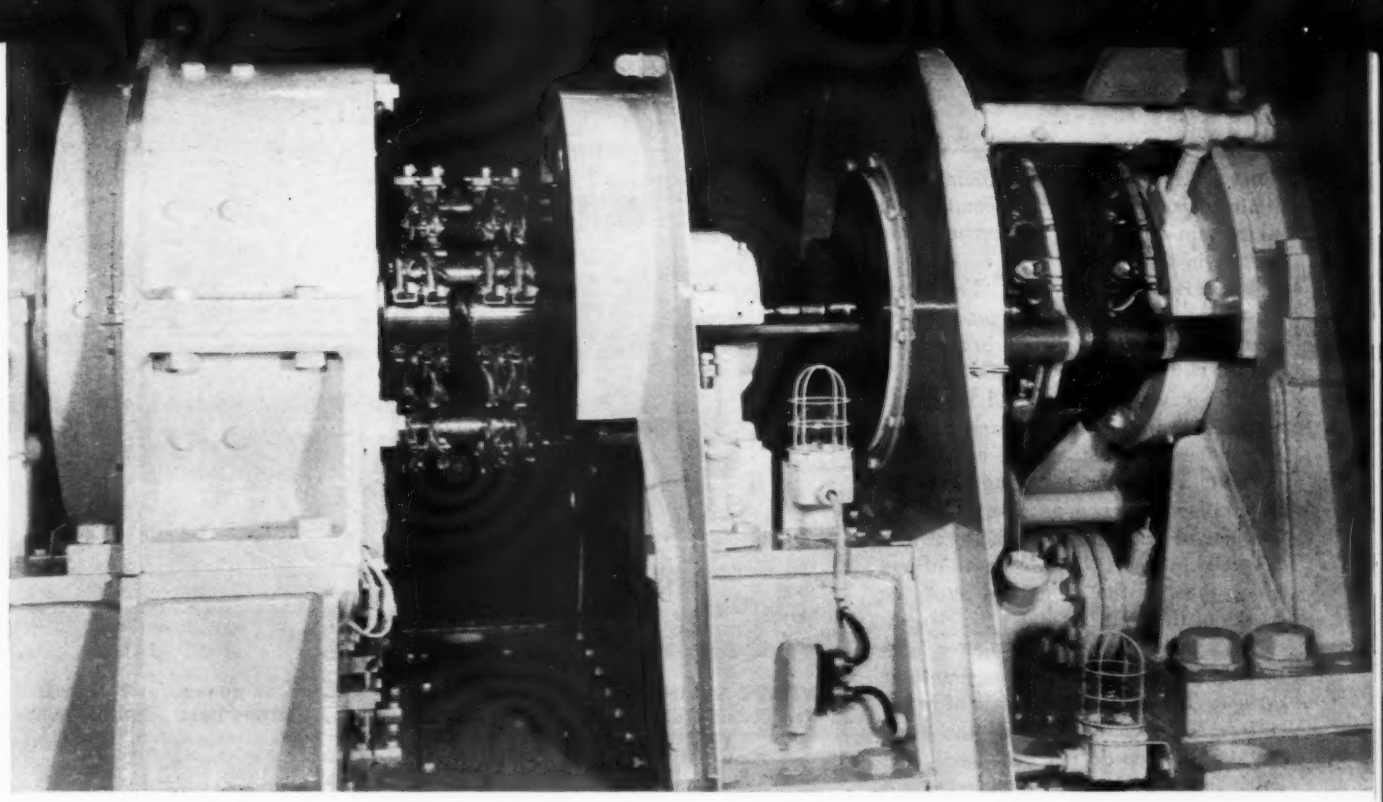
Alternate methods of excitation have until recently used rotating dc machines, usually motor-driven, although sometimes separate small turbines have driven the exciters. With a separate system of excitation, an individual exciter for each ac machine, or a common exciter, has sometimes been used.

Before 1918, most 60-cycle turbine-generators were built for 1800 rpm. Exciter capacities were small, as generators themselves were not large. Because the exciters were small, it was not difficult to build shaft-driven exciters for either 1800 or 3600 rpm turbine-generators.

By 1918, 3600-rpm generators had been built in capacities up to 6250 kva, requiring direct-connected exciters of 50-kw rating. By 1919, 7500-kw sizes had been sold, and in 1927 a unit was built for 3600 rpm, rated at 12,500 kva. This machine had a direct-connected 62½-kw exciter. To date, the largest 1800-rpm turbine-generator is 180,000 kva, with a 375-kw 250-v direct-connected exciter. The largest 3600-rpm unit is 111,800 kva and the largest direct-connected 3600-rpm exciter is 280 kw.

Early Machines. At first shaft-driven exciters were nothing more than open-type conventional dc machines, modified to suit operation of higher-speed units. Such machines were usually one- or two-bearing type, driven from the end of the generator shaft by a crude sort of flexible or solid coupling. At that time, turbine-generators, boilers and their auxiliaries were not very reliable. Units did not operate for sustained periods; shutdowns occurred in normal operation and gave sufficient time for regular maintenance work on the exciters. Photo above shows a 3600-rpm direct-connected turbine-exciter built about the time of the first world war.

Most manufacturers of large-sized central-station 3600-rpm turbine-generators have built direct-connected exciters in sizes up to about 150 kw. Beyond this rating some manufacturers have built shaft-driven exciters coupled to the turbine shaft by a reduction gear with exciters operating at about one-half turbine speeds. The reduction gear requires additional space for the unit; also, a speed of 1800 rpm means an exciter physically twice as large as that for 3600 rpm. The commutator peripheral speed of the 1800-rpm exciter is only about 20% lower than for the corresponding 3600-rpm unit. With



EXCITER ACCESSIBILITY for maintenance of brushes has become progressively more important as service of power-plant equipment has increased. Closeup view of a modern exciter shows the ease with which brush rigging is reached

Pace With Increased Operation

correctly designed current-collecting parts—commutator and brush rigging are the heart of any dc machine—there is no reason to build geared exciters for present-day capacities.

As equipment improved, units could run continuously for longer periods. Exciters were, therefore, modified to give more accessibility for brush replacement, as in the photo above.

Direct-Connected Exciters. It is impossible to get brushes that will last from shutdown to shutdown so a new line of direct-connected turbine-exciters has been designed for continuity of operation. These use pedestal-type bearings, as shown above. To shorten the distance between bearings, armature diameters were made larger and the core length shorter. The ventilating fan was removed from the main exciter. Journal diameters were increased. These changes raise the critical speed, which has always been above operating speed, and add smoothness.

To simplify ventilation, the exciter was turned around with the commutator toward the ac generator. The ventilating fan has two sets of blades with a common discharge. Large blades cool the exciter and the smaller ones draw ventilating air over collector rings and brushes of the ac generator.

Exciter and pilot exciter are a complete unit on a new type of depressed bedplate. This permits removal of main and pilot exciters as a unit if the generator rotor has to be removed. Realignment is effected by simply setting the exciter back on the sole plate and inserting dowels. By depressing the bedplate and building the frame and pedestals on raised sections a large space is provided below the commutator. This new type of enclosed exciter gives more accessibility than open machines of comparable size.

Improved Service. Since service continuity is of prime importance, other factors that normally require maintenance on dc machines have been minimized or eliminated. Armature coils are brazed to commutator necks instead of soldered. This makes a joint as strong as the copper itself. Commutator necks are packed between and behind the bars with insulation so no creepage surface exists. This eliminates all surfaces for collecting flyash and coal dust. Rear end of armature windings, which are normally left bare, are completely insulated. The only surfaces on the rotor that can collect conducting material from the ventilating air are at the commutator necks and next to shrink rings. These are exposed and, when the unit is on slow roll, can be wiped off occasionally with a dry cloth. Other windings, usually of bare copper, are completely insulated with glass tape or other high-grade material.

Large-sized 1800- and 3600-rpm machines require shrink-ring commutators because of stresses in their high-speed operation. Shrink-ring commutators, built over 15 years ago, used massive rings for holding bars in place, binding them down on an insulated barrier on the shaft. Mechanically, such commutators would not fly apart; neither would they stay smooth through temperature cycles. Commutators, therefore, must be designed and constructed to go through temperature cycles and not have uneven bars. On the old construction, as the commutator heated up, the copper expanded, and one or more bars bowed outward slightly between rings. That type made no provision for longitudinal expansion.

The shrink ring of a modern commutator, drawing, p 72, is relatively small in section, and made of nickel-molybdenum steel. Rings are stressed so they always work within the elastic limit. These rings act like a rubber band around the commutator. As the commutator gets larger in diameter because of temperature expansion and

centrifugal force these rings enlarge. They always stretch within their elastic limit, thus permitting the commutator to remain smooth as it increases uniformly in diameter.

Brush Holders Simplified. For about 15 years, medium- and larger-sized dc machines have used double brush holders for two reasons.

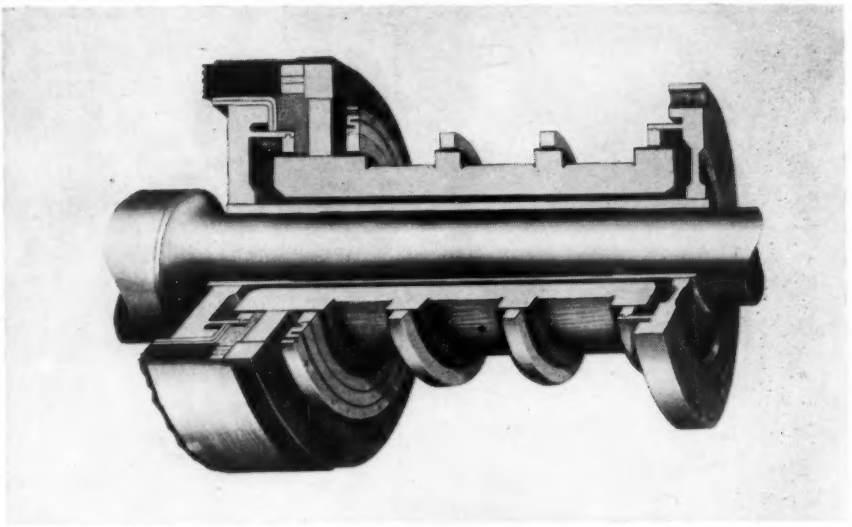
1. Two brushes, separated by a thin partition with individual-pressure fingers on each brush, reduce circulating current. This current, instead of simply flowing from one commutator bar across the face of the brush into the next bar, is forced to travel the full length of one brush through the shunt and back the length of the next brush.

2. Double brushes give better contact between brush and commutator surface. This is because inertia of brush is less and irregularities of the commutator surface do not necessarily lift both brushes. Individual fingers and springs permit separate brush wear.

Pilot Exciters. For many years, standard practice has used pilot exciters mounted on the shaft extension of the main exciter, photo on p 70, to furnish excitation for the main exciter. This eliminates the main-generator field rheostat with its losses and space requirements, and provides absolute stability of the main exciter when operated at any voltage the ac generator requires. Various methods of eliminating the pilot exciter have been tried, such as notching the poles of the main exciter. The weakness of these schemes is the possibility of instability when main exciter operates self-excited at low voltage.

The current per brush on pilot exciter is low—about 2½ amperes. It can be carried directly into the brush from the tip of the brush finger without difficulty. Brushes for the pilot exciter are standard but the shunts are cut off to within one inch of the brush as a means of removing a worn brush. Flexible shunts are used on the fingers, so spring and finger bearings do not carry current.

Separate Exciters. In the past, when motor generators or separate steam turbine-driven dc generators were used as exciters, they were open-type conventional machines. Recent improvements on motor-generator exciters consist of an oversized induction motor and a direct-coupled fly-wheel. This allows the exciter to ride through system disturbances where the motor receives its power from the main generator being served. The ac voltage can drop to 70% of normal value for a relatively long period, or to zero for 0.3 second without loss of stability. This provision is ample for normal fault contingencies.



NEW-TYPE SHRINK RINGS are made so they expand as commutator increases in size because of temperature and centrifugal force; thus bars remain smooth

Electronic Exciters. Ignitron-type exciters have been supplied as a means of excitation for large-sized turbine-generators. When the ignitron receives its power from the generator it excites, special precautions are used against line disturbances. This is necessary because the dc-voltage output of the exciter bears a definite relation to the ac voltage. With some electronic exciters, a small separate ac generator coupled to the shaft of the turbine-generator supplies an independent source of exciter power.

Both of these types of excitation systems are more costly and take up considerably more space than the direct-connected exciter. The rectifier itself, however, can be anywhere in the station. Electronic units are subject to normal hazards of rectifier operation and are oversized so they can operate with part of the unit not normally functioning.

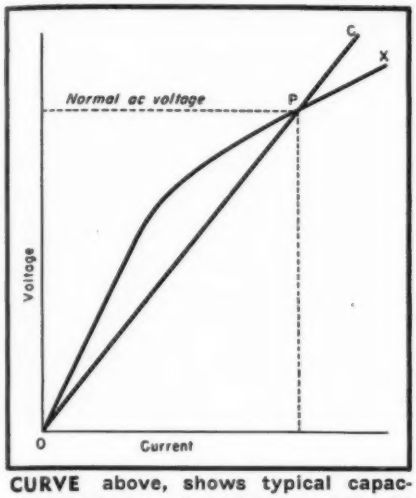
Rototrol Excitation. Rotating regulators, usually built to replace the conventional pilot exciter, constitute a recent improvement applicable to rotating exciters. Several schemes involving *rototrols* have been applied. In one type, the main exciter is a conventional unit and receives its full excitation from a rototrol pilot exciter. In a modified scheme the main exciter is conventional but has three shunt-field windings, diagram on facing page.

In this system, exciter shunt-field winding number 1 provides most of the main exciter-field excitation and receives its energy from the main exciter armature circuit in the usual manner. Field 3 is a small, separately excited shunt field, fed from the station battery or any other source of approximately constant dc voltage. This provides stability at low voltages during starting or any other time that the unit is under hand control.

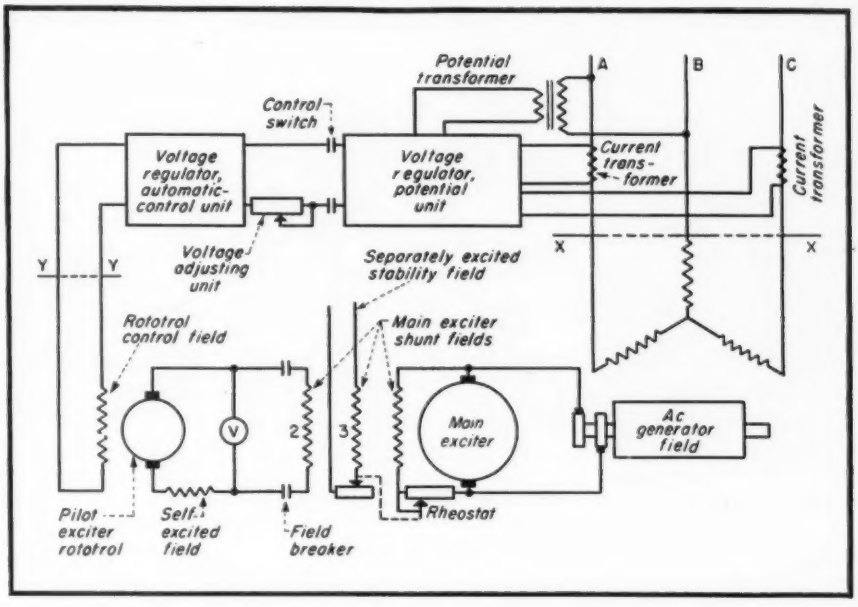
Rheostat arms in fields 1 and 3 are mechanically connected for motor or hand operation, as desired. As the arms turn, resistance is cut into one field circuit and out of the other. Also, the rheostat for the separately excited field 3 is built so at some point, about half voltage on the main exciter, the rheostat is open circuited and remains so as it is turned further in a direction to increase the voltage. This is done because field 3, the stability field, is not needed at higher exciting voltages. This reduces drain on the station battery. Shunt field 2 is excited from the rototrol pilot exciter. This scheme uses a "buck-boost" rototrol pilot exciter.

In diagram, facing page, rheostat on the main exciter is adjusted to provide a base value of excitation for the ac generator. This can be set to maintain steady-state stability at any load desired on the ac generator. The pilot exciter operates so field 2 of the main exciter either adds to or subtracts from the excitation of field 1. This requires the pilot exciter to operate at positive or negative polarity and of a magnitude to produce the necessary excitation. A generator static voltage regulator and the "buck-boost" rototrol pilot exciter produce excitation of the correct polarity and magnitude to maintain the ac voltage in spite of changing loads.

This is better than using excitation for the main exciter from the rototrol



CURVE above, shows typical capacitor-reactance impedance that is used with a static voltage regulator



EXCITATION by buck-boost rototrol is shown in schematic diagram, right

pilot exciter because if anything happens to the pilot or any part of the voltage regulator, complete excitation is not lost, nor would continuity of load be disturbed. In this case, the main exciter, operating as a self-excited generator, provides excitation for the ac generator at some predetermined voltage, say, 75%. If such a failure occurs and the load is other than 75%, the generator continues to carry whatever load is placed on it within its capacity. But the power factor changes, since the ac generator is under- or over-excited depending on whether the load is more or less than the original setting. The equipment continues to function in this manner, even though a short circuit or open circuit develops in the pilot exciter output. This would not be true if fields 1 and 2 of the main exciter were combined, nor if the "buck-boost" rototrol pilot were connected in series with the circuit of self-excited field 1. If a failure does occur, the excitation system can be operated manually.

In the diagram above, only two fields are used on the rototrol pilot exciter; a self-energizing series field, and a control field that combines a differential shunt field and a pattern field. Its excitation is secured from the turbine-generator through a voltage-regulating potential unit and a voltage-regulating automatic-control unit. These two devices are adjustable, but have no moving parts in the sense of an ordinary voltage regulator of the contact-making or rheostatic type.

Voltage Regulation. The various component parts of the voltage-regulating potential unit and voltage-regulating automatic-control unit function as follows:

Current transformers are located on conductors *A* and *C* while a potential transformer is connected to conductors *A* and *B*. Current-transformer *A* supplies a filter reactor, whereas *C* is connected through a resistor to half of the same primary winding of the filter reactor. Output voltage of the two current transformers produced in the secondary winding of the filter reactor is combined with the voltage output of the secondary of the potential transformer to make the voltage regulator responsive to three phase-voltage conditions. Final ac output voltage is a measure of the voltage delivered by the ac turbine-generator, compensated for the load current being carried. This output voltage is fed through the two control switches and a voltage-adjusting resistor into two impedance circuits, one capacitive and the other reactive, each terminating in a rectifier.

The curve shows capacitor and reactor impedances for a static voltage regulator. The relation between the applied ac voltage and the current through a capacitor is a straight line *OPC*. Curve *OPX*, is nonlinear and shows relation of the ac applied voltage and the current in a saturated reactor. With the proper capacitance and reactance, these two curves intersect at *P*, as indicated. This point is chosen to correspond approximately to normal ac voltage on the turbine-generator. The voltage-adjusting resistance unit permits reasonable variations in this voltage, as desired by station operation.

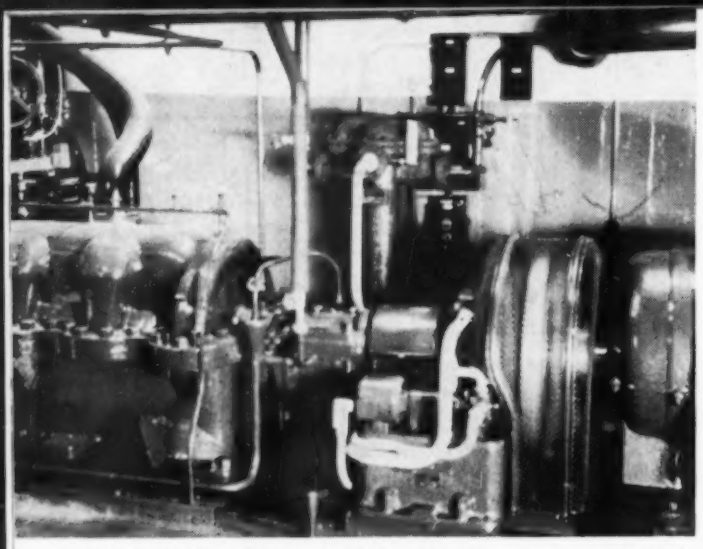
The two rectifier units are connected in series through a mid-tapped resistor. The equipment is adjusted so these two dc output voltages are equal when the ac generator output is at normal voltage. Under this condition there is no voltage output at *YY*, in diagram above.

If ac-generator voltage drops, voltage applied to the capacitor and reactor is reduced so their delivered voltage changes in accordance with the curves above. This produces a different dc output voltage from each of the two rectifier units. When this occurs, the difference is the voltage that appears across points *YY* and is fed into the rototrol control field.

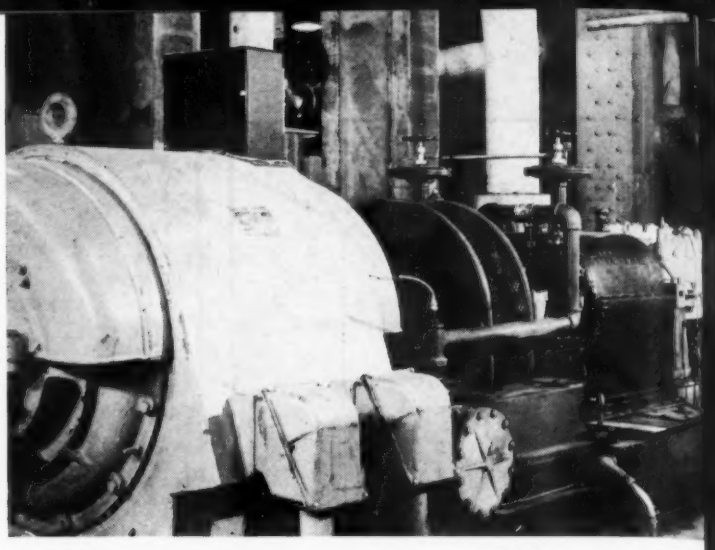
The polarity is such as to cause the "buck-boost" rototrol to increase its voltage, for a drop in the ac voltage. The pilot exciter thereupon increases its voltage and adds excitation into field 2 of the main exciter. This increases the excitation on the main exciter and, in turn, excitation of the ac machine, until its voltage is again brought back to normal. There is then no difference in the output from the two rectifiers and thus no voltage is produced at *YY* and the rototrol control field operates at zero excitation.

If the voltage of the ac generator increases, say, from a drop in load, the same action takes place, but of opposite polarity. Here, the polarity of the voltage from *YY* is reversed and, when delivered to the pilot rototrol control field, puts a voltage of opposite polarity on field 2 of the main exciter. This bucks its voltage downward and decreases the excitation on the main exciter and on the field of the ac machine, bringing ac

(*Continued on page* 134)



FIRST APPLICATION TO FEED PUMPS of an adjustable-speed fluid drive connects a constant-speed squirrel-cage motor, rated 700 hp at 1200 rpm, to a booster pump



CONSTANT-SPEED MOTOR: · One of three 1800-hp 1800-rpm units connected through adjustable-speed fluid drives and gears to 3600-rpm high-pressure boiler-feed pump

3600-Rpm Fluid Drives Adjust Feed-Pump Speed to Boiler Load

High-pressure boiler-feed-system losses are reduced to a minimum with adjustable-speed fluid drives for 3600-rpm pumps. They hold correct boiler level automatically without throttling.

By J D ROSEBROUGH
Staff Engineer, American Blower Corp

► ADJUSTABLE-SPEED DRIVES for draft fans and boiler-feed pumps form a major consideration in steam-plant design. With rising fuel costs and the consequent trend to higher steam pressures for maximum economy, adjustable-speed drives for boiler feed pumps are even more important than for draft fans. In a high-pressure plant about twice as much power is required to drive boiler-feed pumps as draft fans.

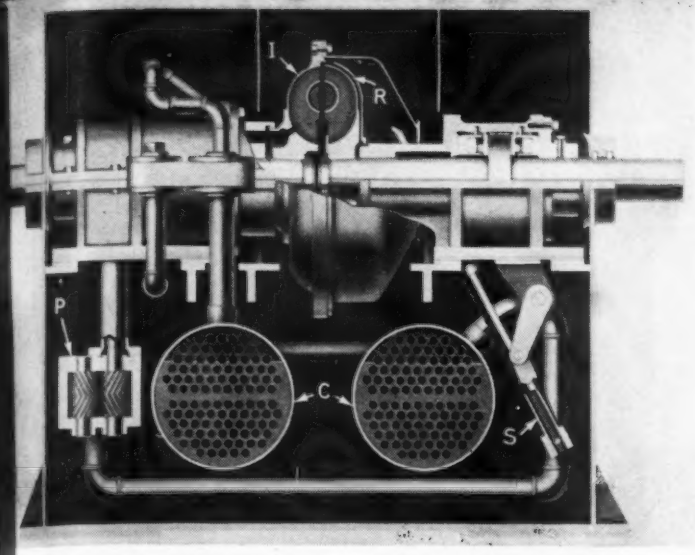
For example, a boiler designed for 900,000 lb of steam per hr at 1500 psi requires 1600-hp on induced-draft fans, 1000 hp on forced-draft fans, with two 1750-hp feed pumps in operation and a third for standby. These pumps develop about 1800 psi when discharging at maximum rate. When they operate at constant speed and are throttled to reduce flow, pressure may rise to 2000 psi or higher.

If the pumps have a flat head-capacity characteristic to keep down pressure rise when throttled, they are less efficient and require more power at reduced flow, and may be unstable. Also, throttling centrifugal pumps for long periods to reduce flow through them may seriously increase their maintenance costs.

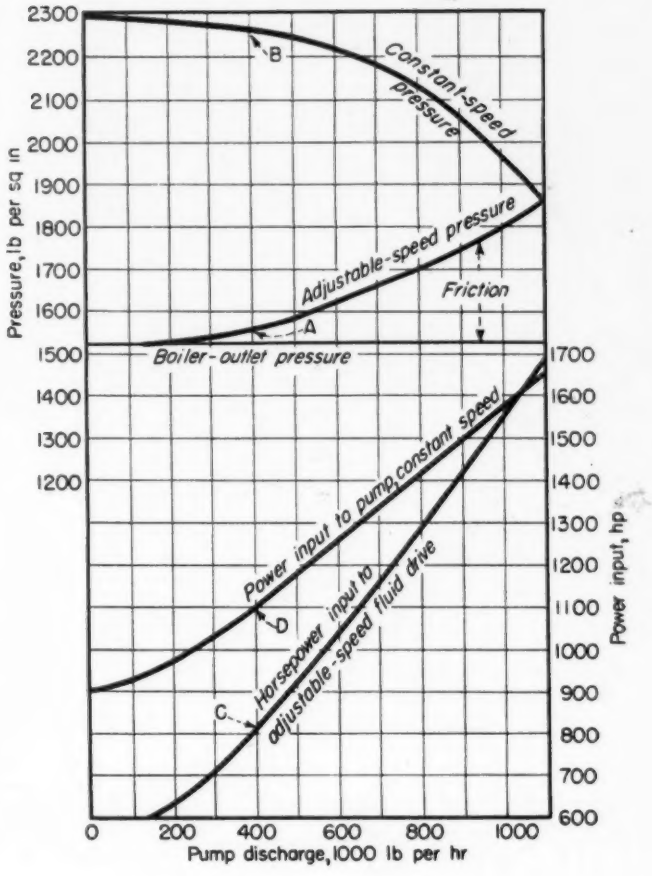
Fluid-Drive Installations. The hydraulic coupling, more popularly known as a fluid drive, has been used extensively for draft-fan and feed-pump variable-speed drives with constant-speed motors. It has two identical vaned rotors, shaped like the halves of a grapefruit, and uses oil as the power-transmission medium. One rotor, the impeller, connects to the driving motor, and the other, the runner, is attached to the output shaft and drives the load (fan or boiler feed pump). The impeller pumps oil into the runner driving it like a turbine through a fluid circuit so arranged that oil circulates continuously from runner to impeller. Efficiency of power transmission at full load is 96 to 97%.

Fluid drives were first applied to boiler feed pumps more than ten years ago, photo at left, in the Philadelphia Electric Co's plant. The two 30-in.-dia drives, used with 700-hp 1200-rpm motors on booster pumps, are still operating. The impeller of each drive is mounted directly on the motor shaft and a heavy casting supports the runner shaft bearings and acts as a manifold for the oil to enter and leave the rotor. The output shaft connects to the pump through a flexible coupling. A small motor-driven control pump transfers oil from the sump to the rotor and also reverses to withdraw oil from the rotor to slow down the speed.

In 1940, three 3600-rpm adjustable-speed boiler feed pumps were installed in the Oswego plant of the Central New York Power Co. These are driven through step-up gears by 1800-hp 1800-rpm motors and fluid drives, photo at right. The control is so arranged that pump speed can be adjusted (1) directly to hold water level constant (2) to control feedwater level by the feedwater regulator valve, and then, with control of pump speed, hold a constant-pressure drop across the regulating valve.



CROSS SECTION through 3600-rpm adjustable-speed fluid drive for boiler-feed pumps. R is runner; I, impeller; P, oil pump; C, oil coolers; S, speed controller



HIGH-PRESSURE boiler feed pump performance during constant- and adjustable-speed operation. With adjustable-speed control, only required feed pressure need be held

This installation marked an advance in feed-pump drives because complete control of feedwater flow to the boilers could be obtained by regulating pump speed with the automatic feedwater-control system. Previously there was doubt as to how fast this type of adjustable-speed drive could change pump speed under such severe service. This installation removed the doubts so several similar installations were made. These drives led to the development of the 3600-rpm fluid drive, cross section above, which is directly responsive to feedwater control and which thus offers full benefit of adjustable speed.

Speed Control. The curves, on this page, show why speed control is desirable for boiler feed pumps. Constant-speed pressure curve is the rising head-capacity characteristic of the boiler feed pump as it is throttled to reduce flow to the boiler. From a flow of 1,100,000 lb per hr down to zero, pump-discharge pressure increases from 1850 to 2300 psi. This sharp rise in pressure is partly caused by decreased friction losses on the suction side of the pump at reduced flow, and by the rising head characteristic of the condensate pump.

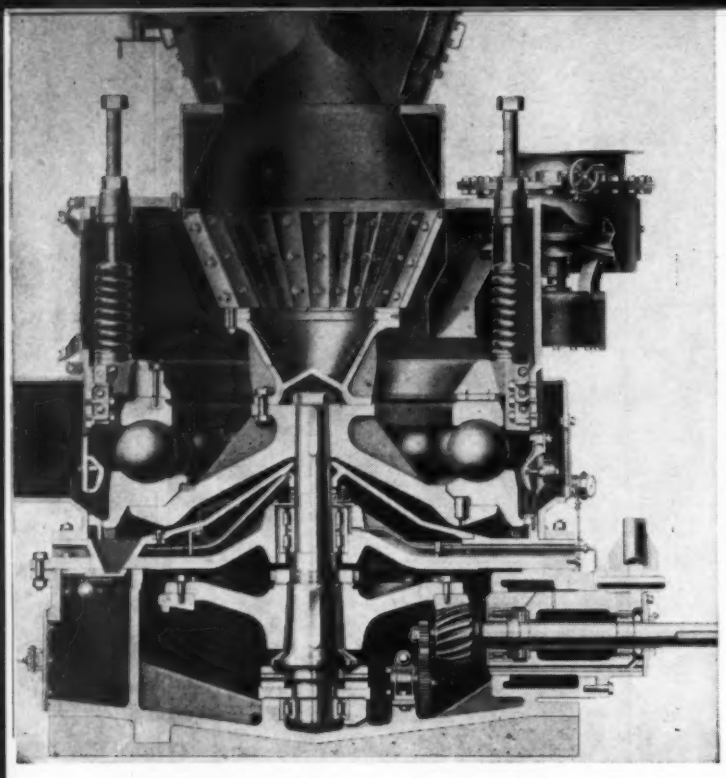
Feed pumps must be selected to develop required boiler-outlet pressure, plus friction losses in superheater, boiler, economizer, feedwater valve, piping and high-pressure heaters, with a margin for blowdown. The pump selected for these requirements is good for much greater capacity than is needed for normal steaming conditions. The adjustable speed-pressure curve, above, shows the required discharge pressure. With adjustable-speed control, only the required pressure need be held and a reduction in pressure of 500 to 700 lb results at low flows, with a corresponding saving in power as indicated by the two bottom curves. For example, at 400,000 lb per hr with adjustable-speed drive, pump-discharge pressure is 700 lb less, points *A* and *B*, and power input is 300 hp less, points *C* and *D*, than with constant-speed drive.

Other savings are also important to the operating department. These are: (1) flexibility of control for starting up and paralleling pumps (2) reduced pump maintenance as a result of lower pressures between stages and less water churning in the pump (3) lower average pressures in the high-pressure feedwater heaters (4) less feedwater valve maintenance.

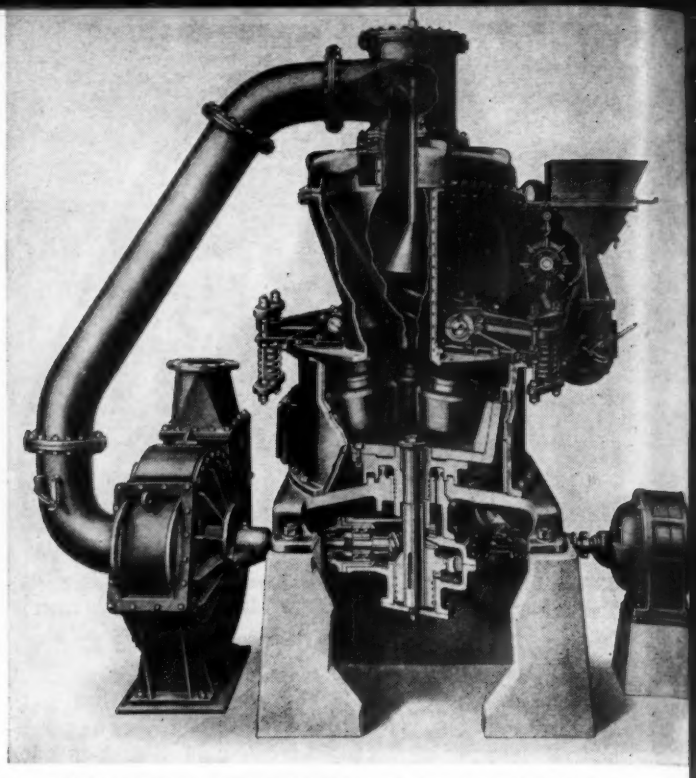
Demands of 3600-Rpm Pumps. To meet the demands for 3600-rpm boiler feed pumps for 500 to 2350 hp, a fluid drive was developed to give: (1) speed response of less than 30 sec over the full range of pump capacity—20 to 25% speed change (2) close, accurate speed control, because of the narrow range of speed over which a pump operates (3) packaged power unit requiring no accessories other than the linkage to the automatic control and the water connections to the oil cooler (4) simple design to keep all maintenance factors out of the adjustable-speed drive.

This drive is enclosed, as in cross section above, in a heavy welded-steel housing. This acts as an oil reservoir, a support for the Kingsbury bearings, and a container for the oil cooler and oil-supply pump. Speed change is by a speed controller that skims oil out of the rotating parts and sets the level according to its position. A continuous supply of cooled oil is fed into the impeller by the oil-supply pump.

Condensate Pumps. While the most important advantages of stepless speed control are realized on the main boiler-feed pumps, there are fluid drives on booster condensate pumps or primary (low-pressure) boiler-feed pumps where good results are achieved at relatively low investment. In these applications the main boiler feed pump operates at constant speed. Since booster condensate pumps feed into the suction of the main boiler-feed pump, the combined total outlet pressure can be lowered by reducing the speed of the low-pressure pump. Most applications of fluid-drives, however, have been on main boiler feed pumps, where full advantage can be taken of adjustable speed.



GRINDING OF COAL occurs between balls and grinding rings. Adjustable springs maintain grinding pressure



WHIRLING BOWL AND ROLLERS mounted on pivoted axes grind the coal thrown between them by centrifugal force

What Part Does Pulverized-C

Atmospheric pollution from pulverized coal comes mostly from flyash. A 200,000-kw plant burning coal of 15% ash can emit up to 10 tons of ash per hr. Here are basic factors affecting the problem from coal preparation to final furnace design

By L N ROWLEY, *Managing Editor*, and J C McCABE, *Assistant Editor*

▶ LET'S LOOK AT the process of firing pulverized coal so we may (1) appreciate the origin and scope of the flyash problem (2) recognize the remedies and their costs in dollars and cents—as much as 5-10% added to steam cost.

What happens when you elect to fire coal in suspension? Within a fraction of a second after a fuel particle in suspension enters the furnace, heat raises its temperature and volatile matter boils off. Air enters the furnace through the burner to mix with distilled gas and complete combustion.

Heat from this combustion process lifts the temperature of the remaining fuel particles to incandescence. Secondary air admitted around the burner opening mixes with the stream of glowing coal particles. It sweeps past them to strip or scrub off successive layers of CO and CO_2 until combustion is complete. First, the coal must be prepared.

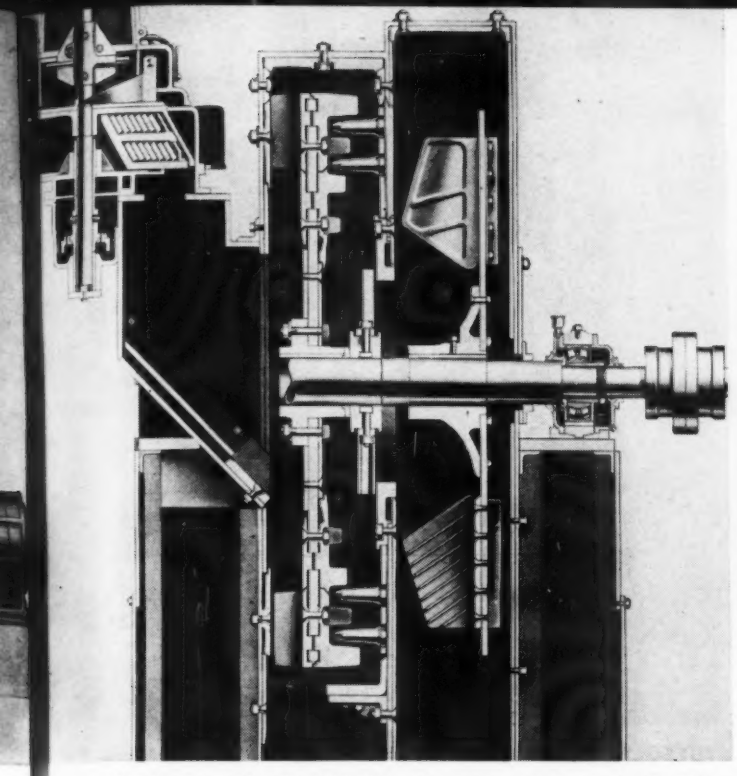
Our article, "How Fuels Burn" (POWER, August 1947, pp 71-72) set up the premise that no fuel burns unless, or until, it becomes a gas. Coal, a solid fuel, requires considerable preparation because it is a solid and differs in composition from one mine to another.

Pulverizing Systems. Pulverizing or breaking up raw coal to a powderlike substance is one way of preparing coal for the combustion process. It can be likened to the "atomization" phase of oil burning in that the surface area of the fuel to be exposed is greatly increased. Once fuel is in this form it must be transferred to the furnace, mixed with the necessary air, placed in the proper temperature environment and given time to burn.

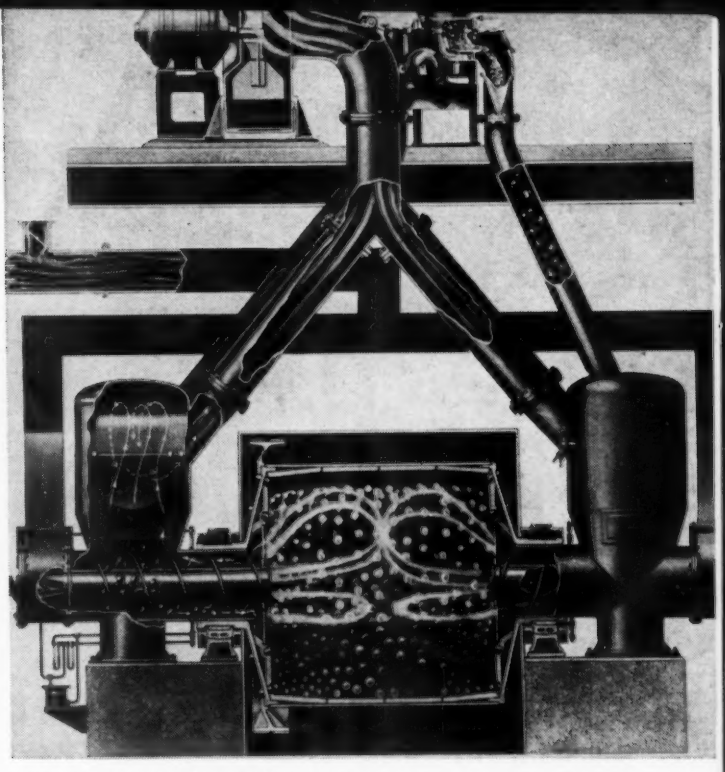
The two basic systems for these operations are (1) the bin-and-feeder (2) the unit or direct-fired system. The older of the two, the bin-and-feeder system, has its major importance in firing coals like anthracite.

Its most serious disadvantage is a heavy capital outlay; usually a separate mill house for drying and pulverizing equipment, plus conveyors, bunkers and feeders for fuel delivery.

But the bin system has important advantages: (1) coal preparation is independent of furnace operation (2) pulverizing mills can operate at opti-



IMPACT FROM HAMMERS of first stage and attrition from pegs of second combine forces to pulverize coal



BALL-MILL PULVERIZER resembles a tumbling barrel with rotating drum filled with coal and heavy steel balls

-Coal Firing Play in Air Pollution?

mum capacity to give uniform fineness (3) large storage bins act as reservoirs against outages (4) use of many burners, individually controlled, gives a flexible furnace, permits adjustment to give optimum combustion.

What about the second, the unit system? Today's unit does four jobs: (1) pulverizes raw coal (2) dries it in the same operation (3) sifts or separates the already pulverized coal within the mill (4) transports this powdered coal to the furnace. All at a large capital saving.

Secret of this saving is a preheated air sweep admitted to the pulverizing mill. The warm air is the drying element, sifting agent and transporting medium. This 3-fold function is not without disadvantage. Each of these operations has one optimum ratio between air and powdered coal for best performance. The same amount of air for all jobs means simply that the choice is the proverbial happy medium.

Transporting Coal. The bin-and-feeder arrangement for pulverizing generally employs a worm-and-screw feeder to push coal to the burner where it becomes air-borne. The unit system uses air sweeping through the mill for its transporting medium. Air-borne fuel, actually a dispersion of a solid in a gas and not too generally understood, can be likened for practical purposes to a liquid.

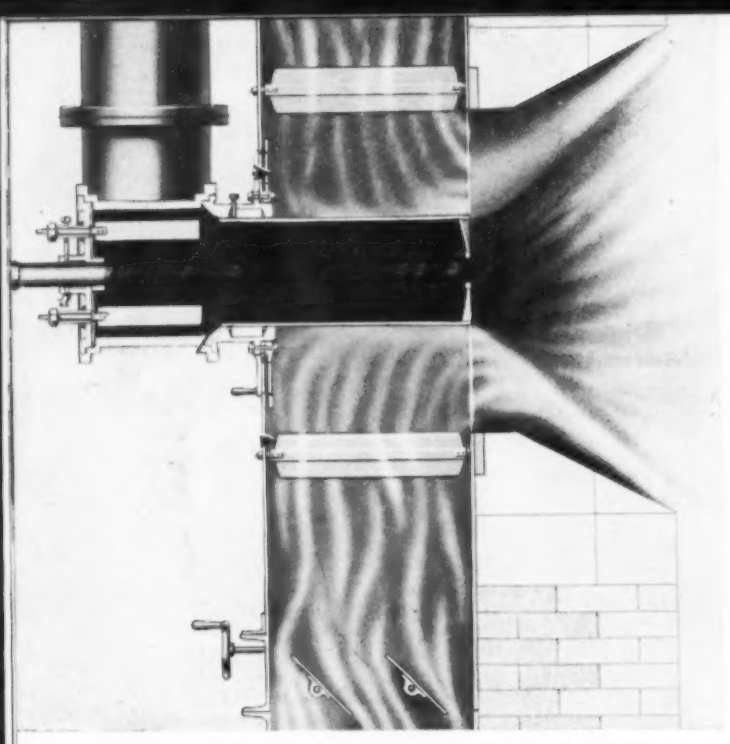
Burner design follows the liquid concept. Its job is to mix the fuel and the primary or ignition air (sometimes the secondary air, too) and then introduce them to the furnace with, often, a turbulent motion, not too unlike the function of an oil burner. In addition, burner design has to do with flame shape and combustible travel time.

Once the fuel-air mix reaches the furnace its travel and combustion differs with furnace design. This design follows one of two principles—the dry bottom or the slag tap. The names come from the means by which ash is removed. In the slag tap, employing higher furnace temperatures than dry bottom, ash is kept molten so it flows from the furnace. To keep it molten many designs direct burner flame into or toward the ash. In dry bottom design the effort is directed toward temperatures below slagging range.

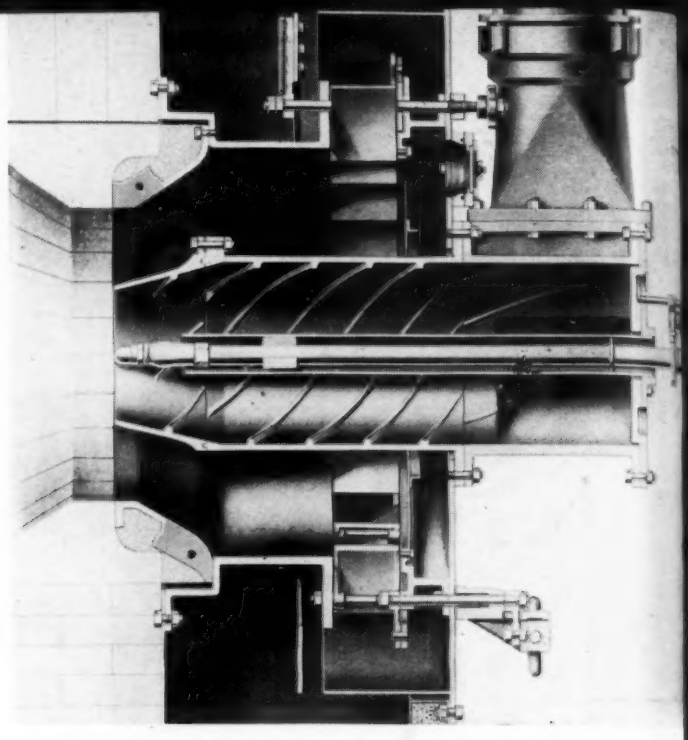
Major Equipment. Pulverizers employ impact, grinding, rolling or crushing action to powder coal (see photos). One recent design, reported capable of ratings up to 10,000 lb coal per hr, has a steam jet for the pulverizing force. All strive for uniform fineness at high throughput and low power consumption. High moisture and ash contents for a given size output, plus a low grindability index in the raw coal undergoing pulverization, constitute the limiting factors on mill capacity. The degree of fineness achieved in the pulverizing process directly affects available surface and, in turn, ignition and combustion.

Preheated air dries, classifies and transports powdered coal to the burner, in the direct-fired systems. If it were always possible to use this medium as the primary or ignition air as well, it would simplify combustion. But this is not always the case.

In general, as the volatile content of a coal decreases, the degree of fineness (and often work of the pulverizer) increases while the percentage of primary air for ignition purposes decreases. A rule of thumb places the percentage of primary air equal to that of volatile-content for anthracite. Sometimes this percentage of optimum primary air is so low that any single volume of air capable of performing all the functions of a direct-fired system far exceeds this optimum figure. Only



BURNER EMPLOYS A ROTARY IMPELLER mounted on ignition tube as a coal spreader, plus adjustable air vanes



TURBULENT BURNER for coal and oil firing rotates incoming fuel and air mixture as well as secondary air

in recent years has the unit system been applied successfully to anthracite. Success hinges on removing excess air from the transporting air before it enters the burner to become primary air.

Burners. There are broadly two types of burners for firing powdered coals: (1) nozzle (2) turbulent burner.

The so-called "fan-tail" or U flame issues from a nozzle burner. Mixing of air and entrained fuel occurs within the furnace chamber. Usually the mixing force is secondary air admitted through separate nozzles. Occasionally a tertiary air is directed through inlet vanes grouped around the primary air and coal inlet.

The turbulent, flare-type burner imparts a rotary motion to (1) the coal-air mixture in a central nozzle (2) the secondary air issuing from a circular chamber around that nozzle—all within the burner. This gives some premixing for coal and air. Turbulence occurs outside the burner.

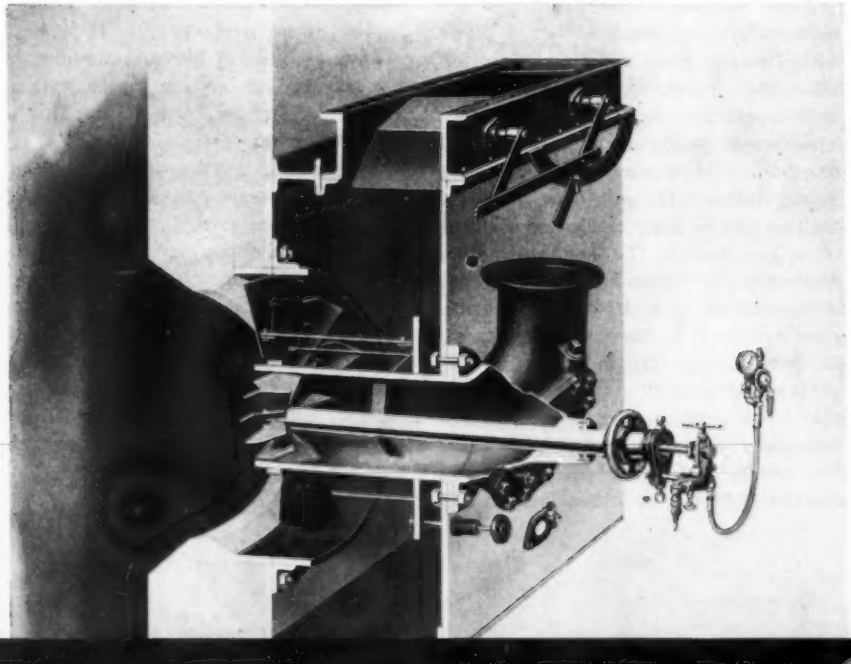
Burners are further grouped according to location in the furnace, that is, vertical, horizontal, intertube, corner or opposed. Early vertical firing had the primary air and coal nozzle at top of furnace chamber pointing downward, more or less vertically. Secondary air nozzles in a wall of the furnace directed air horizontally into the chamber.

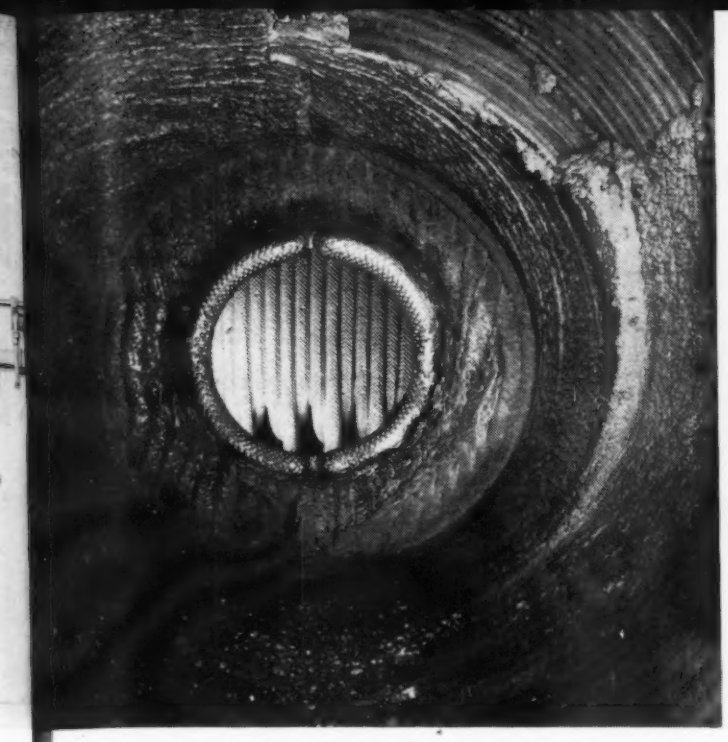
Horizontal, nozzle-type burners, located in opposite walls, to give "opposed firing" or in corners to give "tangential firing" play the flames against one another in the first case and tangent to an imaginary circle in the second. Several advantages seem apparent from such firing (1) a pronounced turbulence can be set up (2) any unburned combustible in the "tail" of one nozzle flame is caught up in the second.

Cyclone Burner. A very recent entry in the field of pulverized fuel firing is the cyclone burner (POWER, Jan 1947, pp 77-80). This burner receives crushed, not pulverized, coal in a stream of high-velocity air tangent to the circular burner housing. The coal thrown to the rim of the burner by centrifugal force and held by a coating of molten ash receives a vigorous scrubbing by the fast moving air until the energy of the incoming air is spent. Secondary air to complete combustion enters also at a high velocity and parallel to the path of the primary air-coal mix. With a temperature in the burner chamber high enough to promote and sustain combustion the stream of primary air combines with the distilled volatiles and the parallel secondary-air flow completes combustion to leave only ash.

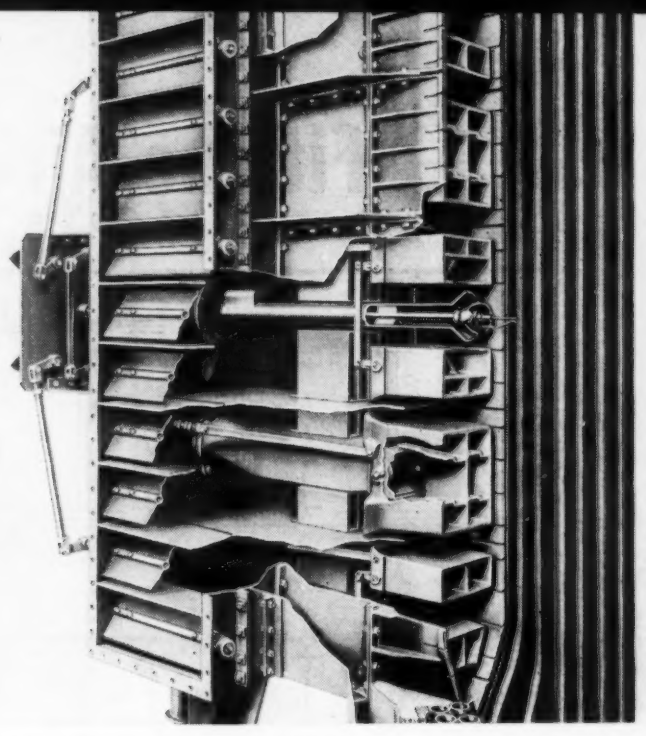
If the fusion temperature of the coal

COAL AND PRIMARY AIR discharge through the coal spreader of this horizontal flare-type burner, make turbulent mixture with incoming secondary air





CRUSHED COAL AND AIR enter cyclone burner with a whirling motion and burn. Slag sticks to the burner wall



TANGENTIAL BURNER directs flame tangent to an imaginary circle in the furnace interior, aids turbulence

is below that reached during combustion the ash becomes molten and under centrifugal force clings to the surface of the burner. By inclining the burner the ash proceeds to the low point of the burner where it discharges continuously.

Combination Burners. The war years emphasized the need for fuel flexibility and since most pulverized-fuel furnaces lend themselves to oil or gas firing, combination burners have been developed. Most combination burners for oil, gas or coal admit all the air for combustion through the burner. Only the primary air carrying coal to the burner is premixed.

Furnace Types. The modern water-cooled furnace, such as is often used in firing pulverized coal, has two functions. It must (1) permit economical burning of fuel and (2) take away or absorb enough of the heat released to hold flue-gas temperatures below the slagging point.

Successful pulverized-fuel firing results from an intensive mixture of coal and air within the furnace proper to give complete combustion in the shortest time and within the least space. First requirement that the flame must meet is not to impinge on combustion-chamber walls. Beyond that blanket requirement for all firing systems, the pulverized-coal installation is characterized by a necessary balance between available coal transport time and combustion time.

Here is why that balance is so important. Temperatures realized in the combustion of most coals are well in excess of the ash-fusion temperatures. Coal burned in suspension, then, has its ash content at one time or another in a molten state. It is highly desirable for the ash to be dry if it is to enter the gas passages of the steam generator. Transfer of heat from the suspended coal particle by radiation to the boiler surface is the only way of attaining this dry state. And it takes time.

Can it be sped up? Yes, fully water-cooled furnaces absorb heat faster than other furnaces. But the time for absorbing the heat usually exceeds the combustion time. This time in a system of suspended-fuel firing is roughly equivalent to distance. So the distance between the burner point and the entrance to the gas surface is a function of the time required for heat absorption. The magnitude of this time or of furnace distance is largely determined by ash content of a given-sized fuel.

There is still one other factor growing out of the ash in suspended coal firing. In the course of combustion, ash particles, while still molten, bump into other ash particles to form still larger pieces. They are often too large to stay in suspension, so drop out. The accumulation of these pieces presents a problem of removing them from the furnace.

At this point a choice may be made whether to keep the ash, when once molten, in that state or to return it to the dry state before removal. That in a nutshell is the reason for the two different designs—the slag tap for molten-ash removal, the dry bottom for dry-ash removal.

What steps can be taken to reduce atmospheric pollution from pulverized-coal firing? This pollution problem is almost entirely one of flue dust, or flyash as it is often called. Smoke can and does occur in arrested combustion—where flame impinged on tubes, or fuel feed went badly out of balance from, say, moisture hanging up the raw-coal supply. But the major problem is one of flue dust.

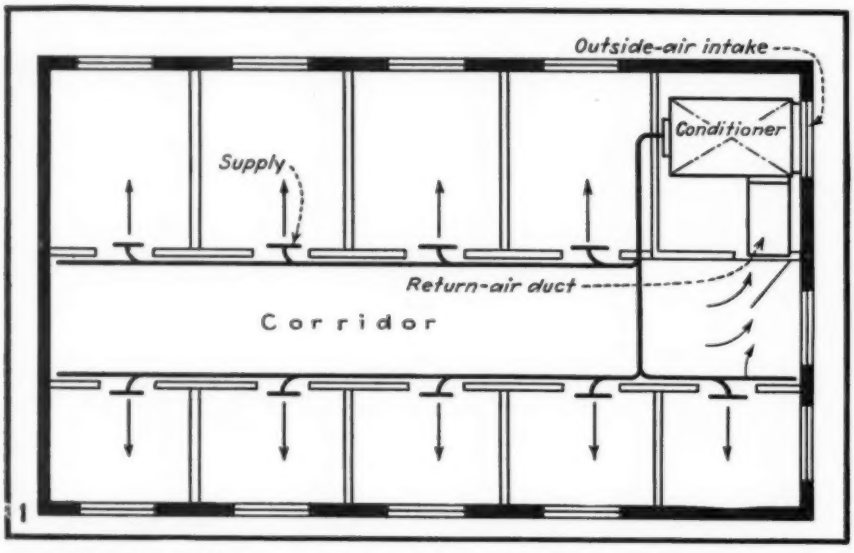
Flue dust is a byproduct of suspension firing of a solid fuel. Its quantity, by weight, can be reduced by striving for complete combustion. Here are some operating aids.

The pulverizing mill promotes good combustion by delivering uniformly fine coal to the coal transport system. This system, in turn, should distribute coal uniformly within the feeder aided by orifice or directional vanes.

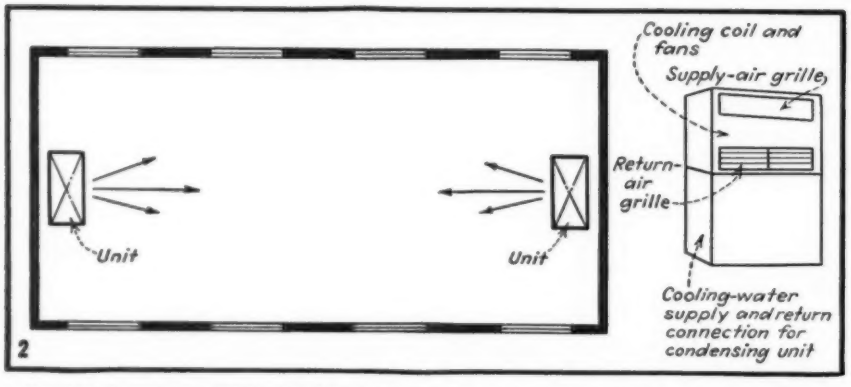
Good burning depends on suitable coal, clean burners, proper mixing. Designs should permit a primary air as close as possible to the optimum ignition air ratio for all loads. For extremely low loads use separate burners.

Design improvements represent the principal hope for reduced flue dust to atmosphere from pulverized-coal burners. Removal of entrained flyash from flue gas by external collecting equipment will be discussed in a later article in the series.

Fit the Air-Conditioning System



THE CENTRAL PLANT, being quite flexible in its field of application, can condition large areas or numerous small rooms if the duct space is available



ONE OR MORE SELF-CONTAINED UNITS can be installed at the load. With this arrangement amount of outside air that is necessary comes in by infiltration

Economy in choice of equipment requires a balance between operating expense and fixed charges. But a slight variation either way may decide whether occupants are completely satisfied: Part I

By J D CONSTANCE
Professional Engineer

► SELECTION OF air-conditioning equipment is based on the principles of psychrometry, air flow and, to a great extent, on heat-transfer data. Application requirements that affect selection depend largely on the elements of air conditioning: temperature, humidity, air purity and air motion. Let's look at the factors affecting system design.

Determining Size. Capacity of equipment depends on gain or loss of sensible heat and moisture to the conditioned space. Controlling factors of these gains or losses are (1) temperature and humidity to maintain (2) quantity of outside air introduced (3) effects of sunshine and occupancy and (4) miscellaneous internal heat sources, ranges, steam tables, etc.

Total quantity of air supplied and the method of introducing it must provide even temperature distribution and adequate air motion without creating unpleasant drafts. Design characteristics of each element in the system, including the controls, should meet application requirements under varying conditions of operation. Preliminary work in designing an air-conditioning system involves: (1) careful survey of premises, (2) calculation of cooling load (3) selection of type of system (4) choice of equipment.

The survey involves collecting information to determine application requirements, cooling load, best method of air distribution, and best location and arrangement of equipment, as well as careful evaluation of constructional and architectural features of the building to get a harmonious layout.

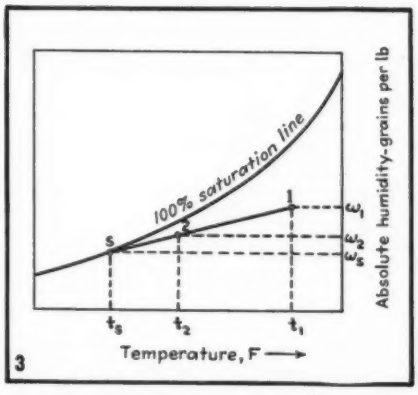
System Selection. What type of system to use involves a consideration of numerous possibilities, such as a unit system, or central plant with zoning arrangements. Essential difference between a central-plant system, Fig. 1, and unit system is in the location of the air-conditioning machinery and the methods of air distribution. A unit system, Fig. 2, is usually factory assembled whereas a central-plant system can be either tailor-made in the field or made from factory-built assemblies that are flexible enough to permit incorporating special design features. The central-plant conditioner is more flexible in its field of application.

To a certain degree the application determines the type of system, as follows:

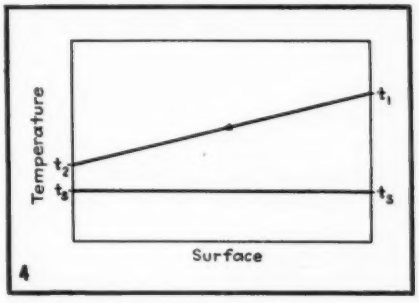
Large rooms with highly concentrated loads generally require a central plant. Here the air must be carefully distributed and projected over wide areas without annoying drafts. Air streams leaving the supply outlets must be properly thrown to effect *ribbons* of air that mix with room air in the right areas. Extensive duct-distribution systems may be the only way to get such acceptable conditions and hold occupancy complaints to a minimum. Furthermore, reducing the total number of operating units minimizes the number of moving parts, as well as water, drain and electrical connections.

A number of small rooms, however, may be handled by either a unit or central-plant system. For example, an existing building may lack space to

To the Load



SKELETON CHART of psychrometry solves temperature, moisture problems



HEAT-TRANSFER PROCESS from air to evaporator is shown by line t_1 to t_2

erect a duct system or the duct work may interfere with the architectural arrangement.

A single definite procedure, which directly determines the combination of equipment that best meets the fundamental requirements of adequate performance and lowest cost, is inherently impossible because of the large number of variables involved. For instance, a given capacity may be obtained with one combination of heat-transfer surface and cooling-medium temperature, or with a greater amount of surface and a higher cooling-medium temperature. The former is more economical in cooling surface cost, but requires more expensive refrigerating equipment than the latter.

To illustrate further, the same capacity may be had at a fixed temperature of cooling medium with various combinations of cooling surface and air flow. Combination with the least airflow volume requires the largest and most expensive cooling surface, but the smallest and least expensive fan and duct distribution system.

Air Temperature. Relation between quantity and temperature of delivered air is very important; it is, in fact, too often a deciding factor between success and failure. After all, the occupant is more interested in how he feels than in the mechanical features of a system. For example, air may be introduced at a dry-bulb temperature of, say, 15 or 30 F below the dry-bulb temperature to be maintained in the conditioned space. Same load requirements are satisfied with half the volume of air delivered at the latter temperature differential. Fan and duct sizes are, therefore, smaller for the 30-F condition.

This temperature difference, known as diffusion, has certain practical limitations that are affected by ceiling height and supply-grille design. A rough criterion is: If the rate of air supply is equivalent to a complete space volume change in 6 to 8 min, it should be relatively simple to arrange the supply and return grilles to provide satisfactory air and temperature distribution and air motion. Under ordinary conditions practice does not recommend allowing air changes to fall outside these limits.

Design Considerations. In selecting equipment, consider carefully the previously mentioned methods of introducing air to the conditioned space, relative costs of the air conditioner, refrigeration, refrigeration equipment and air-distribution system as well as design characteristics of the equipment. In selecting the latter to meet specified capacity requirements use a skeleton psychrometric chart such as Fig. 3.

Dehumidification. The air can be dehumidified by passing it over a cooling surface or through a water spray, either of which is maintained at a temperature below the initial dewpoint of the air. Problem is to select the surface and its temperature so dehumidification and sensible heat absorption will be in a proportion that just offsets the moisture and sensible-heat gains of the space being maintained at a certain predetermined dry-bulb temperature and relative humidity.

In Fig. 3 moisture content or absolute humidity forms the vertical scale or ordinate, and dry-bulb temperature the horizontal scale or abscissa. The curve represents the weight of water vapor associated with a unit weight of air at atmospheric pressure. In a conditioner, air at a certain temperature is introduced to the cooling surface indicated as point 1. Dry-bulb temperature would be t_1 and humidity w_1, expressed as grains of water vapor per pound of dry air. If a point S is located on the saturation curve at the temperature t_s, and a straight line drawn connecting point 1 and S, then some point, 2, located on this straight line, represents the condition of air leaving the surface, and its dry-bulb temperature is t_2.

Temperature at point 2 varies depending on: (1) rate of air flow (2) area of cooling surface (3) depth of cooling-coil surface parallel to flow (4) sensible heat-transfer coefficient of the surface and (5) entering-air and surface temperatures. Humidity at this point becomes automatically fixed and for cooling-coil installations is usually approximately 90% relative humidity. Dry-bulb temperature of air leaving the surface cooler may be calculated from equations of heat transfer and energy conservation (symbols defined, p 83):

1. $H_s = A_s\, h_s\, (t_a - t_s)_m$, Btu per hr
2. $H_s = 0.24 \times M \times (t_1 - t_2)$, Btu per hr

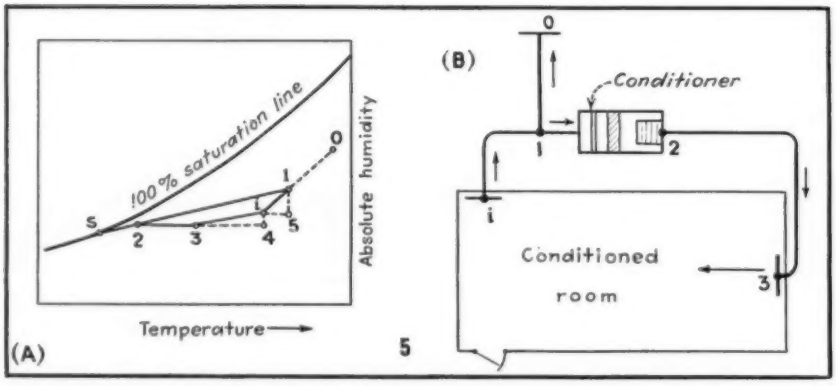
The log mean-temperature difference $(t_a - t_s)_m$ is most generally used and may be defined by the equation:

3. $$(t_a - t_s)_m = \frac{t_1 - t_2}{2.3 \log_{10} \dfrac{t_1 - t_s}{t_2 - t_s}}, \text{ F degrees}$$

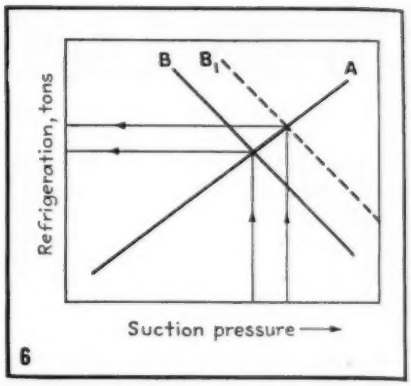
Fig. 4 shows graphically the heat-transfer process. Temperature of heat-transfer surface t_s is constant throughout but air is cooled from the dry-bulb temperature t_1 to t_2. The difference $(t_2 - t_s)$ is called the smaller, and $(t_1 - t_s)$ the larger. If the ratio of larger difference to smaller is less than 2 the arithmetic mean temperature may be used with about a 4% error, which is commonly acceptable. Otherwise, the log mean temperature is determined by equation 3. The arithmetic mean may be expressed:

4. $$\frac{(t_1 - t_s) + (t_2 - t_s)}{2}$$

Slope of cooling line 1-S in Fig. 3 depends on cooling-surface arrangement. The deeper the coil in the direction of air flow, the steeper the slope and the more latent cooling accomplished at the expense of sensible-heat removal. Substance of this principle is that when air is cooled by a surface having a temperature less than the initial dewpoint temperature of the air, dehumidification or latent-heat removal, expressed in heat units, is a definite percentage of the sensible-heat reduction. Important thing is that this dehumidification ratio is determined from psychrometric principles. The equa-



SKELETON PSYCHROMETRIC CHART: A shows the air-conditioning cycle at points corresponding to those indicated on a simplified layout of the system, B



CONDENSING-UNIT capacity curve A superimposed on that of evaporator B

tion that relates this ratio to the temperature and humidity of the entering air and the surface temperature is:

$$5.\quad H_1/H_s = f = 0.62\,\frac{w_1 - w_s}{t_1 - t_s}$$

Cooling, Dehumidification. Let's now consider what takes place in the system. Return air from the conditioned space mixes with outside air in the suction box of the air conditioner. Mixture is then filtered before coming to the cooling surface. Sensible heat and moisture are extracted at rates equal to the sensible- and latent-heat gains, respectively. This treated air, which is now cooler and drier than the average, or design, indoor condition, is finally distributed to the conditioned space.

Fig. 5*A* associates the process on the psychrometric chart with a schematic layout of the mechanical system, Fig. 5*B*, showing point locations in the system. Mixing of outside air with return air may be represented on the psychrometric chart by a straight line joining the points representing initial stated conditions. If we let point *O* represent the condition of outside air, fixed by design outdoor dry- and wet-bulb temperatures, then point *i* represents the condition of inside or recirculated air, fixed by design, indoor, dry- and wet-bulb temperatures.

Resulting mixture is then represented by 1, which is so located that the distance from *i* to 1 bears a percentage relation to the distance from *i* to *O*, equal to the outside air-supply volume expressed as a percentage of the total circulation. In other words, if the outside-air supply is taken as 25% of the total handled by the conditioner, resulting mixture condition is expressed by a point 75% away from point 0. If the ratio of outside air to inside air were 50-50 the resulting mixture would be expressed by a point midway between 0 and *i*. Usually point 1 may be determined by laying off the distance along line 0-*i*, as explained.

The air is then cooled and dehumidified in the conditioner, leaving at point 2. Air leaving a dry-coil conditioner is never saturated because of bypassing and incomplete cooling and turbulence. Reduction of dry-bulb temperature is just equal to that necessary to absorb an amount of heat equal to the sensible-heat gain. In like manner, the reduction of absolute humidity corresponds to the latent-heat gain realized in the conditioned space.

Only sensible heat is picked up by air in the duct and the rise in dry-bulb temperature is $t_3 - t_2$. Length of the line from 2 to 3, Fig. 5*A*, is proportional to the sensible-heat gain in the system. Air is then introduced to the conditioned space at a temperature and humidity represented by point 3. In an actual system the unintentional heat gain from 2 to 3 should be kept to a minimum by insulating the supply duct in unconditioned areas.

In the conditioned space the air supply absorbs sensible heat and moisture until its condition is represented by *i*. Length of line from 3 to 4 is proportional to the sensible-heat gain of the room alone and exclusive of the sensible-heat gain of outside air supplied mechanically and mixed with recirculated air.

Length of line from 4 to *i*, Fig. 5*A*, is proportional to latent-heat gain of the room exclusive of mechanical outside-air supply. After picking up its quota of sensible and latent heat, air removed from the room is at condition *i*. Mixing with outdoor air increases its moisture content and dry-bulb temperature to the condition represented by 1. Distance from *i* to 5 is proportional to the sensible-heat gain from outdoor air, and the line from 5 to 1 is proportional to the latent-heat gain. In actual practice, air conditions follow the paths shown by solid lines.

Equipment Selection. We have not said much about how air is to be brought to condition 2. As mentioned, this may be done by passing air over a surface having the correct temperature, determined by extending the straight line joining points 1 and 2, until it meets the saturation curve at *S*. In actual design, however, the extension may fail to intersect the saturation curve. This will be discussed later.

If intersection with the saturation curve is obtained, required size of cooling surface can be determined directly from the sensible-heat load. Thus, from equation 1:

$$6.\quad A_a = \frac{H_s}{h_a\,(t_a - t_s)_m}$$

Refrigeration equipment is selected on the basis of total cooling load and required cooling-medium temperature. Latter depends on total cooling load and coefficient of heat transfer from surface to cooling medium, as given by the following relation:

$$7.\quad (t_s - t_r)_m = \frac{H_t}{h_r \times A_r}$$

Judgment must be exercised in selecting an economical combination of heat-transfer surface and refrigeration equipment. Equation 6 shows that the greater the mean-temperature difference between air and cooling surface, the less surface required. Referring to Fig. 3 for fixed entering-air and surface temperature, mean-temperature difference may be increased by increasing t_2. But an increase in t_2 is permissible only by increasing total air flow because:

$$8.\quad t_1 - t_2 = \frac{H_s}{0.24 \times M}$$

This is equivalent to saying that a

SYMBOLS USED IN THE EQUATIONS

ALL TEMPERATURES ARE DRY BULB, F.

$(t_a - t_s)_m$ = mean-temperature difference between air and heat-transfer surface, F.
$(t_s - t_r)_m$ = mean-temperature difference between heat-transfer surface and cooling medium, F.
w = water-vapor content of moist air, grains per pound of dry air.
h_a = coefficient of heat transfer between air and heat-transfer surface, Btu per hr per sq ft per F.
h_r = coefficient of heat transfer between heat-transfer surface and cooling medium, Btu per hr per sq ft per F.
A_a = area of heat-transfer surface exposed to air, sq ft.
A_r = area of heat-transfer surface exposed to cooling medium, sq ft.
M = weight rate of air flow, lb per hr.
Q = volume rate of air flow, cfm.
H_s = sensible-heat capacity, Btu per hr.
H_l = latent-heat capacity, Btu per hr.
$H_t = H_s + H_l$ = total heat capacity, Btu per hr.
$f = H_l/H_s$.
0.24 = mean specific heat of moist air over range of conditions encountered in comfort applications, Btu per lb per F.

given amount of heat may be removed from a large quantity of air with less heat-transfer surface than is required with a smaller flow of air. Thus, an important point to consider is an economic balance between air quantity and heat-transfer surface, together with a careful consideration of the effect of air temperature and quantity on the method of introducing it to the conditioned space.

In determining the economic balance let's confine the discussion to a system composed of a refrigeration condensing unit (compressor and condenser) and a direct-expansion cooling coil. Fig. 6 permits a direct visual appreciation of the relative importance of each contributing factor. Separate performance of condensing units and coils can be easily computed, but once the two have been connected, the situation changes. Condensing unit and coil act as a single unit, and every change in the operating conditions of one affects the other; performance of the combination depends on their individual characteristics. Let's again look at Fig. 6.

Refrigerating capacity of a condensing unit varies with system suction pressure. A condensing unit, operating at a given speed and using a definite quantity of condensing water at a certain temperature, heated through a certain temperature range, presents a characteristic curve *A* (straight line), Fig. 6. Capacity in total tons of refrigeration increases with suction temperature and pressure.

Like condensing units, capacity of an evaporator or cooling coil varies with suction pressure. Capacity decreases, however, with rising suction pressure as illustrated by curve *B*, representing a certain surface area over which a definite volume of air passes under certain temperature and humidity conditions.

If a condensing unit is selected for a given refrigerating capacity and suction temperature, an evaporator having a like capacity at the same suction temperature must be chosen, but once the two are connected they act as a unit. Changes in air conditions through the coil are the most critical factors because other variables remain reasonably constant. Thus, warmer and more humid air displaces curve *B*, upward and to the right parallel to its original position B_1. As a result the system operates at a higher suction pressure, develops greater capacity, and gives greater sensible-heat removal but less latent-heat removal. Where load varies widely, divide the conditioned space into zones having their own peculiar latent and sensible-heat loadings. Each zone can be controlled separately.

Selecting Design Conditions. In comfort applications, select design indoor conditions carefully. A slight modification in the design humidity will, under certain conditions, effect an appreciable saving in equipment cost because the comfort zone, discussed completely in the ASHVE *Guide*, covers a wide range of relative humidities.

For example, consider an application in which there is but little latent heat gain compared to sensible in the conditioned space. If the coil selected balances the load and removes latent and sensible heat in the same ratio as they are picked up in the conditioned space, the line 1 to 2, Fig. 3, will be nearly horizontal, and the resultant surface temperature required, t_s, might be so high as to require a very large cooling surface, since in equation 6, $(t_a - t_s)_m$ would become smaller. By decreasing the design-indoor humidity slightly, a lower surface temperature will be required to move the additional latent heat. As a result, $(t_a - t_s)_m$ will be greater and permit the use of less surface operating at a lower refrigerating suction pressure.

Editor's note: Next article will solve problems on design.

MIT Sets Up Gas-Turbine Lab

Massachusetts Institute of Technology has established a gas-turbine laboratory. At the dedication ceremonies, Karl T Compton, president, emphasized the significant possibilities and the importance of research in this field in training engineers.

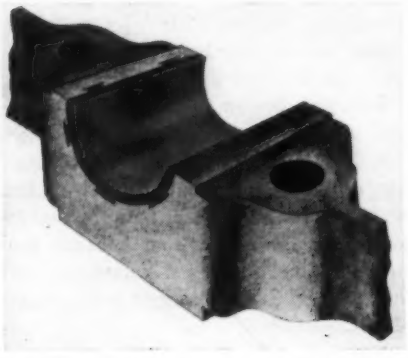
Long-range research will be the major objective under the guidance of Edward S Taylor, director. Equipment includes a high-speed wind tunnel capable of operating at three times the velocity of sound.

It also has a cascade device for the study of flow through compressor and turbine blades. A compressor able to supply air at 50 psi at a rate of 6 lb per sec to combustion apparatus is also present.

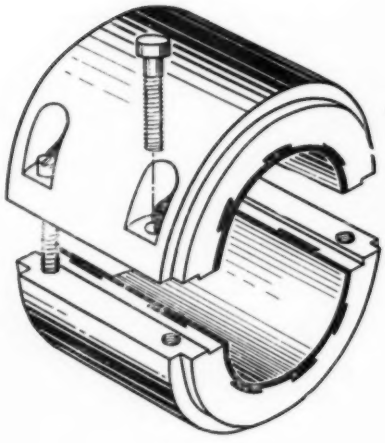
The gas turbine is well adapted to long-range research as it is easily separated into its major components, including compressor, combustion chamber turbine proper. Several projects were begun during the construction period.

Heavy contributors to the laboratory's construction were: Alfred P Sloan, Jr, chairman of General Motors, General Electric Co, Westinghouse Electric Corp, United Aircraft Co, General Machinery Co, Curtis-Wright Corp and the U. S. Navy, which furnished certain equipment.

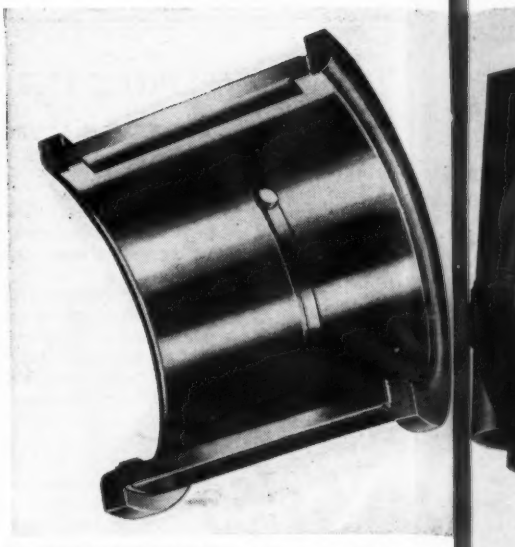
DIESEL-BEARING EVOLUTION FROM CAST-IN TO SLIP-IN



BABBITTED bearing cast in place in housing serves in slow-speed engines



INTEGRAL bearing was forerunner of some present designs. Cylinders held together by bolts were babbitted and machine-finished on outside diameter. This design reduced lining thickness, hand fitting needed for replacement. Rebabbitting could be done at factory



INTERCHANGEABLE design comprises bronze back with centrifugally cast lining; finishing stock is provided on ID for machining or scraping to fit

For Top-notch Diesel Operation Know

To meet today's heavier demands, improved bearings have been developed. Here's the way they came into use, the reasons why, and an explanation of their mechanical construction features*

► CONDITIONS IN DIESEL ENGINES make life tough for bearings. To meet these ever more severe demands, bearing designs have undergone radical changes since Isaac Babbitt introduced the bearing alloy now known by his name.

The early idea was to apply a generous quantity of a high-tin alloy directly to a cast-iron or bronze housing. Because chemical bonding was unknown, mechanical means of making the lining stay in the housing had to be used. Methods included tapping large holes with coarse threads, and tapping and screwing-in flat-head screws, but the common procedure involved casting or machining dovetail grooves into the housing (see above). In large diesels, lining sometimes reached a thickness of 1½ in., or more.

In spite of casting difficulties, such bearings worked rather well where unit loads were low and speeds slow. Nevertheless, wear eventually reached a point where the babbitt had to be recast and brought to a fit, an operation requiring time, equipment and skill, and success was not always sure.

Yesterday's Bearings. Forerunner of some present bearings was the *integral* design, consisting of a babbitt-lined split cylinder held together by bolts. The OD was machine-finished to fit the housing. Thus main bearings could be assembled to the crankshaft and the whole laid into a bedplate bored to mate OD of bearing backings.

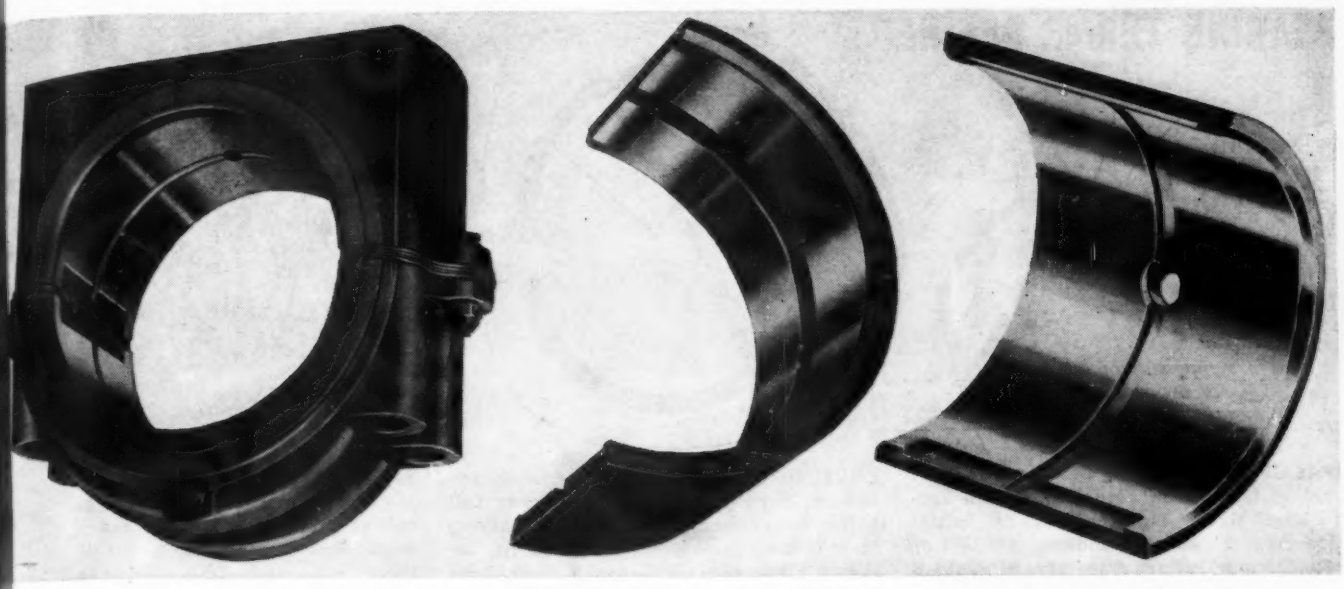
In this design, lining thickness was reduced to $\frac{3}{16}$ to $\frac{3}{8}$ in., depending on backing material and thickness. Dovetail grooving was less drastic, but still used in most cases. These bearings could be replaced, with some hand fitting and shimming, and rebabbitting and machining could be done by the engine builder or a bearing maker.

Next step was the *interchangeable* unit, consisting of a backing, usually bronze, with suitable lining material centrifugally or gravity cast by modern methods capable of obtaining a chemical bond between lining and backing. Allowance for finishing was made on the ID. Bedplate and corresponding mainbearing caps were bored and the bearing OD machined to fit them. Stock was usually left at the parting faces, as well, for subsequent fitting. Methods of boring the assembled bearings to fit the shaft were sometimes employed, but usually laborious hand scraping was considered best.

Resulting oil-clearance was variable, and high and low spots on the bearing surface could not be avoided. Also, because bearings were finished to height by hand filing, contact of these surfaces with the corresponding half bearing was not too accurate. Linings still had to be relatively thick (⅛ to ¼ in.) to offset inaccuracies in initial bedplate boring as well as to allow for hand scraping. When bearings of this type are put in new engines today the linings are machine bored to a truly round hole for a round shaft.

Development of methods for chemically bonding lining to backing led to occasional direct babbitting of crankpin boxes. Elimination of lining anchor-

*At the 19th National Oil and Gas Power Conference of the Oil and Gas Power Division, ASME, four comprehensive papers on bearings were presented by E Crankshaw and G W LaPier, Cleveland Graphite Bronze Co; R J Esarey, National Bearing Division, American Brake Shoe Co; W E Thill, Federal-Mogul Corp; and D B Wood, Aluminum Co of America. This article, and another to follow, is a condensation and free adaptation of these papers.

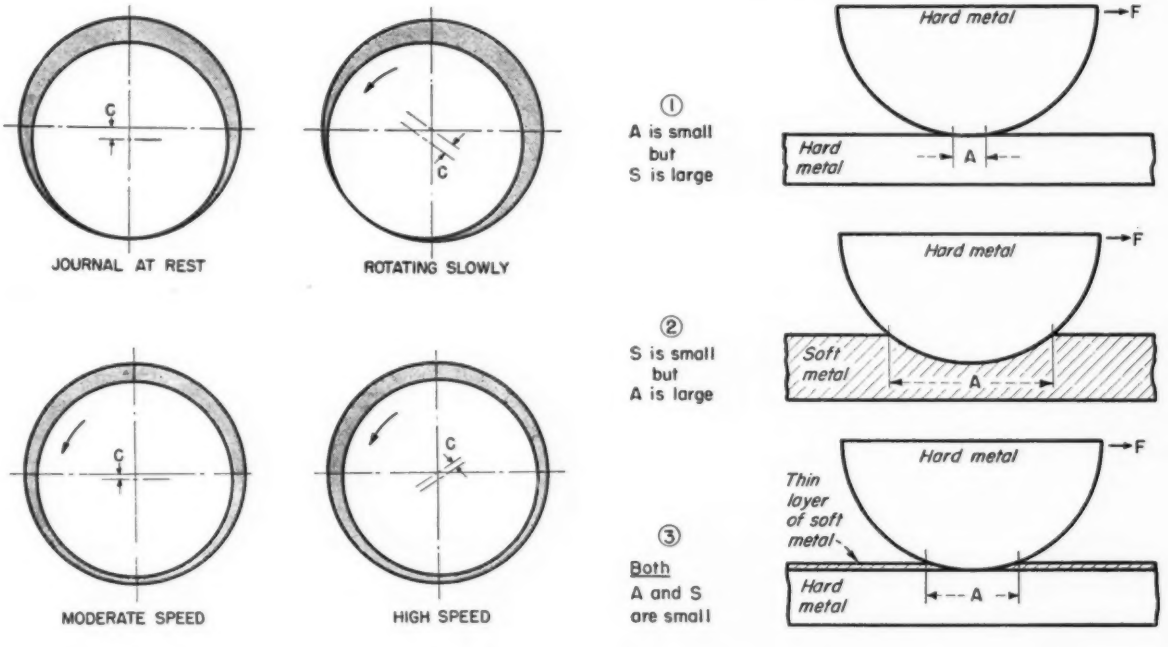


CRANKPIN BOX without bearing insert, babbitt being chemically bonded directly to box. Used occasionally

PRECISION bearing consists of a backing and thin lining machined for interchangeable fit before assembly

MONO-ALLOY bearing follows mechanical features of precision-insert design but is made of a single metal

Your Sleeve-Bearing Fundamentals



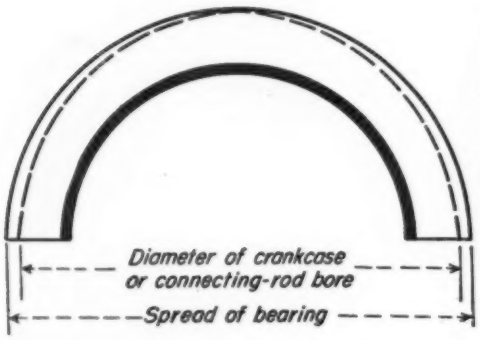
HOW BEARING OIL FILM FORMS

Theory pictures formation of oil film as shown above: At rest, actual contact exists between shaft, bearing. When shaft starts to turn, it tends to roll to left. Speed rises, shaft drags oil into wedge-shaped space, pressure builds up, lifts shaft off bearing. At full speed, hydraulic pressure tends to push shaft to side

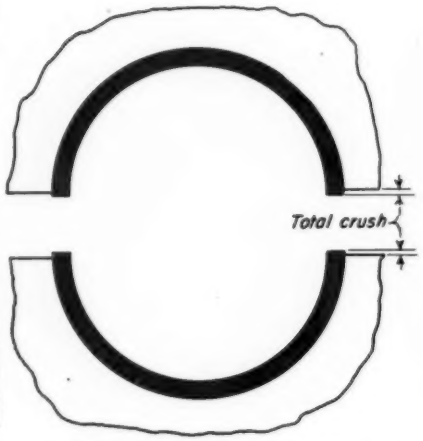
METALS IN DRY FRICTION

Some metal-to-metal friction usually occurs in any bearing. Frictional resistance is proportional to the real area of contact A and the shear strength S of the softer metal. As diagramed above, the desired condition of keeping both A and S small is obtained by thin film of soft metal on hard metal

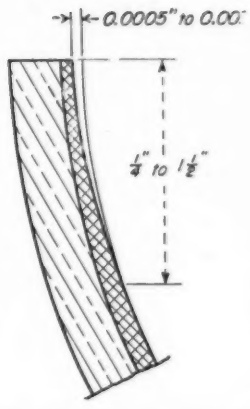
BEARING TERMS DEFINED



SPREAD is making the bearing wider at parting faces than actual maximum saddle-bore size. This creates an initial side pressure so any tendency on part of ends to curl after assembly is avoided



CRUSH is the term used to describe the excess in height of a bearing over full half. At assembly, pressure at parting face forces equivalent of press fit, insuring close contact between back, bore



PARTING RELIEF, incorporated in some precision bearings, makes sure that bearing's sharp edge does not rub on shaft if there is sidewise misalignment

ages made it possible to reduce lining thickness still further.

Hand scraping, necessary to some extent in all these designs, is expensive and time consuming. Successful operation depends on the skill of the scraper. To get rid of these troubles, manufacturers developed accurate ways of boring bearings at assembly, and today's *precision-insert* bearing.

Today's Bearings. As its name implies, the precision bearing is an accurately finished unit consisting of a bronze or steel backing to which is bonded a lining material. Mated to saddle bores, journals and crankpins held to equally close tolerances in manufacture, such bearings are completely interchangeable and directly replaceable. They can be stocked as spares and bearing replacement can be made with comparatively little shutdown time. If the shaft is not damaged or worn excessively, clearance is restored accurately without machining or hand fitting.

Precision bearings are available with either steel or bronze backs, choice being sometimes dictated by engine builders' preferences, and sometimes by lining material required. A recent development is the bearing made of a single material, such as one of several aluminum alloys. These combine sufficient strength and rigidity with suitable antifriction characteristics.

THEORY OF BEARINGS

Improvements in bearing design have gone hand in hand with gains in knowledge of what happens in operation, although much remains to be learned. The formation of an oil film is usually pictured by simplified diagrams such as those on the preceding page. In commercial engines, however, there are some parts of the pressure area where oil film is so thin it must be measured in molecules, and others where metal-to-metal contact exists. Such thin-film (boundary layer) and metal-to-metal conditions also exist during starting and stopping.

Dry-Friction Theory. A theory of dry friction developed by Dr F P Bowden helps to explain further the operation of bearings. As pictured on the preceding page, frictional resistance is proportional to the area of real contact between the metals A, and the shear strength of the softer metal S. When a hard substance rubs another hard one, contact area is small but shear strength is high and so is frictional resistance. With a hard substance rubbing on a soft one, the low shear strength of the soft metal is offset by the greater area of contact.

But if a hard material rubs on a thin film of a soft one over a hard back, both area and shear strength are low, giving low frictional drag. Extensive plastic deformation and penetration of the hard material cannot occur so even with heavy loads real contact area stays low. Resistance to shear is fixed by the softer metal, so this provides an artificial method of keeping both A and S small.

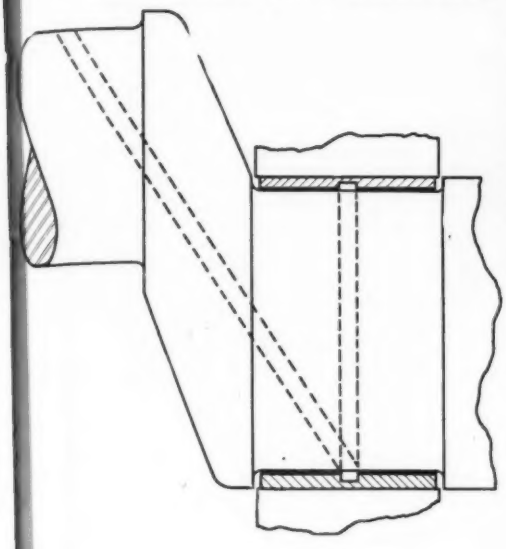
In actual practice, small areas of metal-to-metal contact act to melt the thin film in spots, providing contact area necessary to support the load, thus actually tending to form a uniform bearing area conforming more to the shaft and its deflections, and housing distortion, than the original. This dry-friction theory helps to explain success of thin plated films as "run in" surfaces and as means of adding corrosion resistance to known bearing metals.

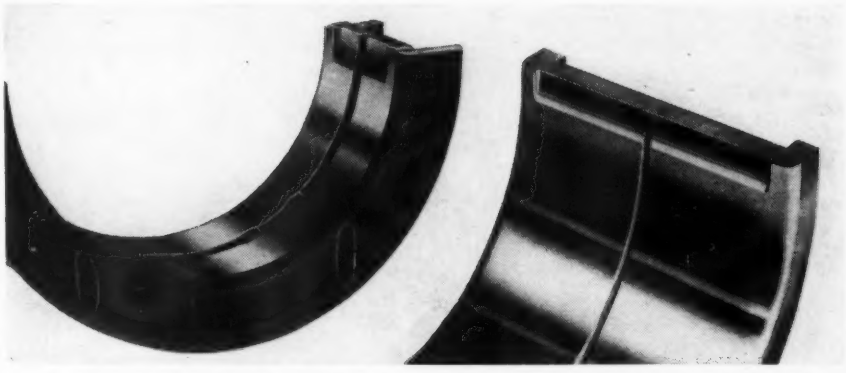
Trend in Linings. It has been seen that the trend is toward thinner linings and, in some cases, backs. This permits casting bearing material with increased soundness and uniformity, more advantageous engine assembly and improved operation, and lower cost. Selection of lining material (to be discussed in detail later) and its final thickness is not haphazard. It is based on study of loads, speed, oiling conditions and other factors governing behavior of the bearing in the engine. Such items as engine cleanliness, crankshaft deflection and other unpredictable factors require that past experience also be considered.

Based on test results and successful experience, lining thicknesses have moved steadily downward in the past few years. In automotive practice, thickness runs as low as 0.004 in. nominal, about a practical minimum from the standpoint of bearing manufacturing economy. In diesel bearings the trend is also toward thinner linings since a thin lining is subjected to less stress and has greater flow resistance. In diesels, however, manufacturing economy is not usually the determining factor. When thin linings become excessively worn they ruin expensive crankshafts quicker, so a compromise in lining thickness to provide a greater margin of safety is desirable. Present-day diesel-bearing linings range in thickness from 0.015 to 0.040 in., depending on bearing size and to some degree on the kind of lining material.

Half bearings for diesel connecting

OIL-GROOVE POINTERS





GROOVING TO CONVEY OIL: In conventional main-bearing design, full peripheral groove is supplied with oil for transfer to connecting-rod bearing through crankshaft oilway. Rule of thumb says cross-sectional area of groove should be at least ¼ area of the crankshaft oilway

GROOVING FOR OIL DISTRIBUTION: Grooving in highly loaded areas is discouraged, but it is often desirable in low-load areas to aid in properly distributing lubricant. At right, above, is grooving for long or large bearings; at left, "thumbnail" grooving for flanged bearings

rods and mains are purposely made with certain dimensional peculiarities to render them more substantial when assembled. Operators should know what these are and what they accomplish.

Bearings are usually made wider across the parting faces than actual saddle-bore size, as shown above. This is known as *spread*. It creates initial side pressure so that, after assembly with the opposite half, any tendency for the ends to curl is eliminated. The fact that this also assures firm seating proves helpful to the mechanic, as housing and bearing can be inverted without the latter falling out.

Bearing Definitions. *Crush* is the term to describe the excess in height of a bearing over the full half. It imposes pressure against the parting faces of a pair of bearings after assembly in the housing, creating an equivalent press fit and assuring good contact between bearing back and housing-bore surface.

Excessive crush can be more harmful than it would seem, causing distortion and thickening of the wall, thus impairing the oil clearance. In manufacture, this half height must be held rather close, between 0.0005 and 0.001 in. total tolerance. Special fixtures are used to check this dimension under known loading.

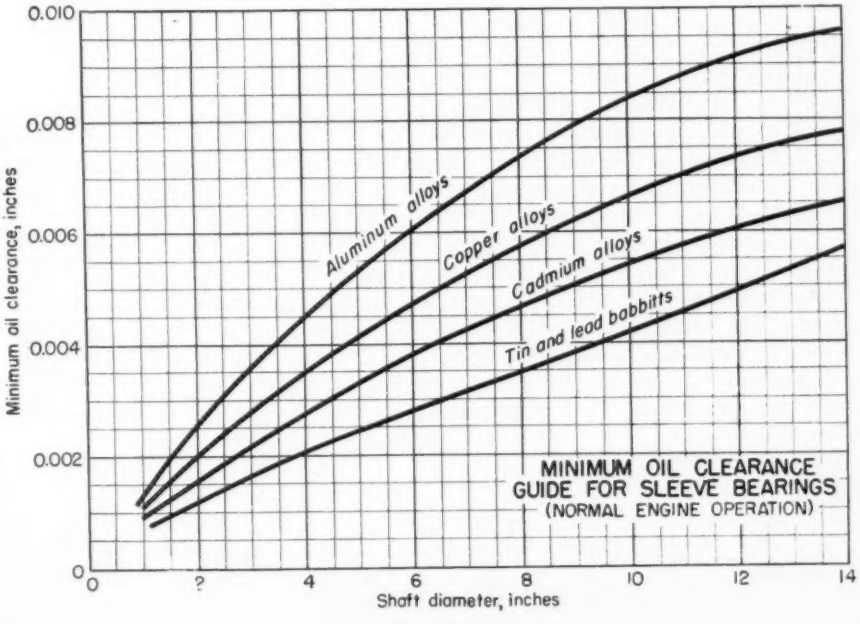
Flanged bearings with proportionately large flanges require an additional relief of the flange at the parting faces to a depth of 0.002 to 0.005 in. Because the flange has no backing support and the remainder of the bearing is practically press fitted in the housing, the flange tends to warp if this precaution is not taken.

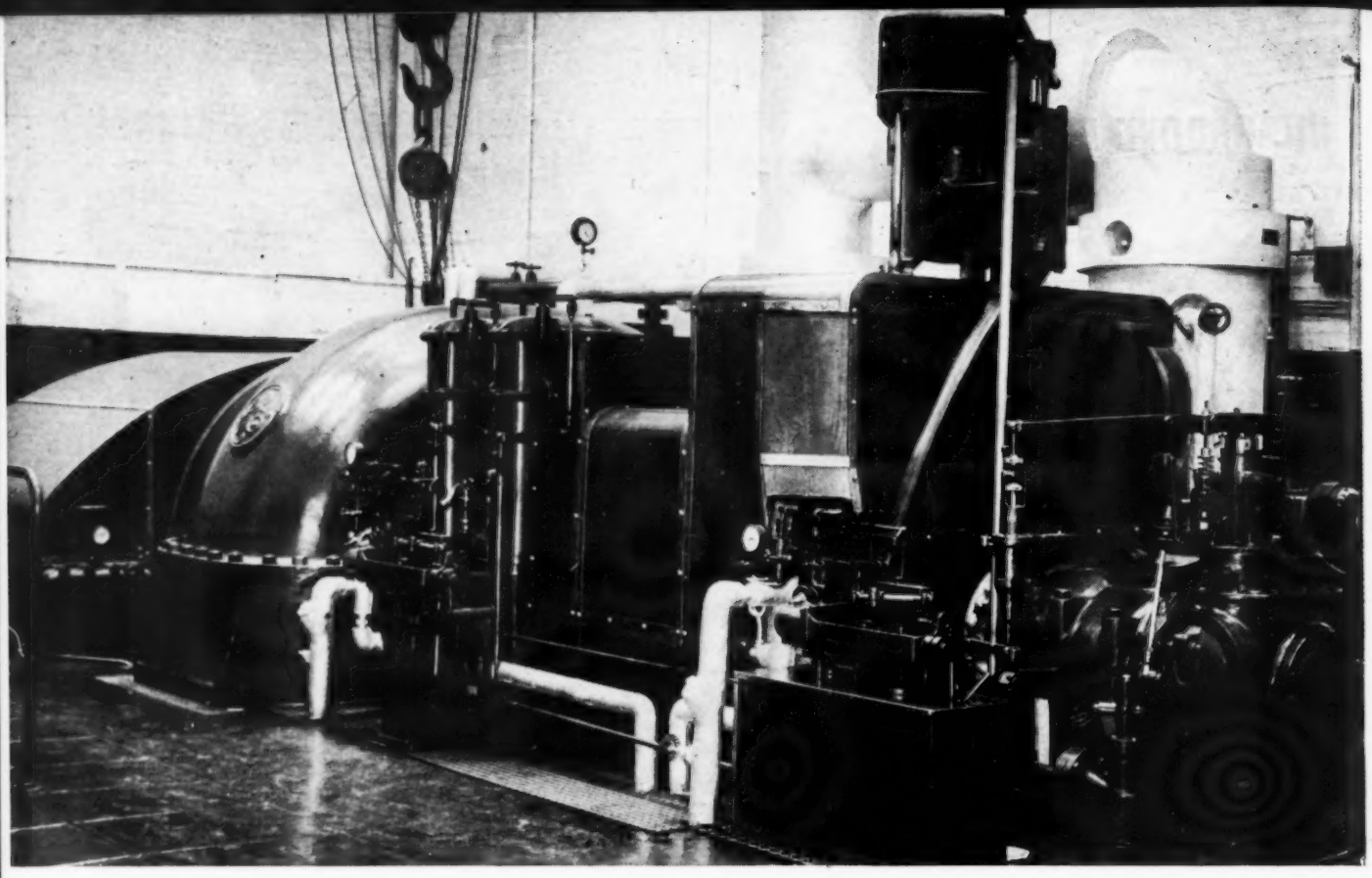
Another feature frequently incorporated in precision bearings is *parting-face relief*. This is so small as to be indistinguishable in the finished bearing. Its purpose is to make certain that the sharp edge of the bearing does not rub against the shaft because of slight sidewise misalignment at assembly. If this occurred, the oil film would be scraped off. This relief also assures that any slight burr set up at the parting faces by the crush will not touch the shaft. Amount and length of taper depends on bearing and shaft size.

Oil Grooves. Oil grooving is a specific problem for each bearing as related to the total installation. The day is gone when indiscriminate "lattice-work" grooving was considered smart design. Instead, we have learned that each groove reduces allowable local load-carrying ability because the oil-film pressure ordinarily built up to high intensities is reduced by the swath cut into the otherwise uninterrupted surface of the bearing.

Oil grooves must be used sparingly and judiciously. This does not imply that they should be eliminated entirely for, when properly applied, they assist in formation of oil films. Wherever

(*Continued on page* 160)





EVEN THOUGH UNITS LIKE THIS turbine run smoothly up to inspection time, resist an urge to postpone dismantling

Establish Adequate Maintenance

Protect investment, minimize operating costs by taking steam turbines out of service for inspection at regular intervals. Alf Hansen, turbine specialist, General Electric Co, tells what to look for and how to correct troubles at the start

▶ A GOOD MANY INDUSTRIAL COMPANIES operate their power plants with little or no standby capacity. And yet a forced shutdown for one day may cost a company the equivalent of the average annual profit on the power plant. Best way to insure continuous power-equipment operation is to establish a planned schedule of inspection and maintenance.

Some of the gains from a generating installation are lost if an extraction steam turbine is not available and boilers feed process steam direct to low-pressure lines. Modern turbines, among the most reliable prime movers today, accustom operators to smooth, continuous operation. So they are occasionally tempted to postpone inspection periods until definite indications of faulty operation develop. Nevertheless, planned shutdowns for inspection (1) reduce forced outages (2) produce reliable power at minimum cost (3) insure safety of personnel and property.

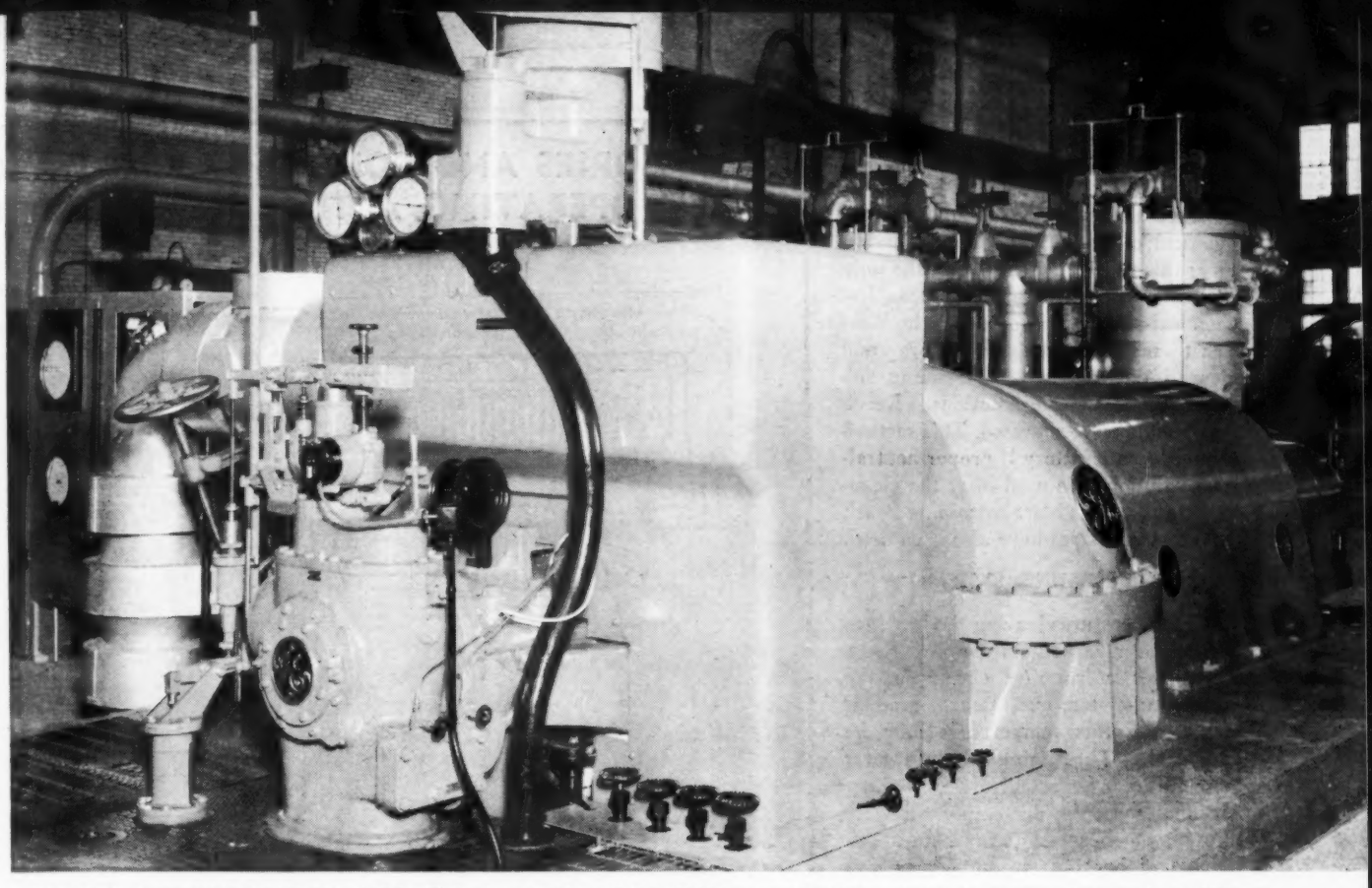
After a sound maintenance schedule has been established, don't gamble by running a turbine a year longer just because it seems to operate smoothly at the time of a planned shutdown.

Spare Capacity. Most continuous-process plants of medium size or larger have standby equipment. Plants with a spare turbine-generator have no difficulty adhering to an established maintenance program.

When erected some plants have standby units, but increased production demands require all units to be on the line continuously. So production must be curtailed during inspection periods and inevitably equipment does not receive necessary attention. Attempts are made to crowd a 2-week inspection period into a long weekend, but a more practicable procedure would be to take down the powerhouse equipment during a 2-week annual-vacation shutdown for the entire factory.

INSPECTION FREQUENCY

No general rule for frequency of inspections can be applied to all industries or even to all plants within the same industry. One large industrial concern operated a turbine for eight years without an internal inspection. Again, a hospital plant ran two small turbines 12 to 14 years without lifting the upper half of the turbine casing. Undoubtedly these power-plant operators had good reasons for their disregard of conventional maintenance schedules, but this practice cannot be



ADEQUATE INSTRUMENTATION AIDS efficient operation of this 2500-kw condensing unit by detecting abnormal conditions

Program for Industrial Turbines

recommended generally. Moreover these operators will probably be the first to agree that shorter intervals between inspections are desirable for both safety and economy.

Another industrial concern, operating three 2000-kw condensing turbines, at one time spent from three to four weeks for annual inspection, cleaning and overhauling of each unit. Their accurate records show that money for this work was returned in fuel savings within two months after the equipment went back on the line.

Some 10 or 15 years ago manufacturers recommended annual turbine inspections and many users still adhere to this conservative practice. Today, in the utility plants, turbines are inspected within 12 months after going into service, and then after every 10,000 operating hours. If a turbine is not in daily service it may be well to keep the interval between inspections at 10,000 operating hours, but not let total elapsed time exceed three years.

Who Makes Inspections? Some industrial plants have maintenance men they feel are competent to inspect and overhaul their turbines, but most concerns find it more satisfactory to employ the manufacturer's field engineers to supervise this work. The latter practice is highly recommended because the service engineer is factory trained and kept advised of new developments, and is in constant touch with the equipment designers.

Most industrial insurance companies have inspectors in the field, primarily for their own protection. When contemplating an inspection notify the insurance company so their inspector may make his own observations.

RECORD KEEPING

Turbine inspectors should have a thorough procedure for systematic checking and recording of wear, erosion, gradual deterioration and functioning of governors and safety devices. References at the end of this article cover various phases of turbine inspection and overhaul.

Condition of all wearing parts of a turbine should be listed in the inspection report. Photographs, sketches or templates may supplement this information. Comparison of these data for succeeding inspections will enable predicting when parts should be replaced and preventing failure in service.

Copies of inspectors' reports should be in the files of both user and manufacturer so that the life history of the unit is readily available to the parties principally interested.

Operating Records. By properly logging certain readings hourly the operator effectively "takes the pulse of the machine."

Stage-pressure records indicate where scale accumulates in the turbine steam path. A suddenly increased stage pressure usually results from a foreign object passing through the turbine and denting or restricting the nozzles and buckets. A gradually increasing stage pressure is usually caused by scale deposits. When stage pressures plotted against steam flow show an increase of 10%, it is time to do something about it.

If deposits are soluble in water, the

steam path may be washed with saturated steam without dismantling the turbine. For deposits consisting mostly of silica scale or other insolubles, mechanical cleaning is the most satisfactory; this requires dismantling the unit.

During the war some shipyards and chemical-cleaning concerns on the West Coast removed turbine rotors and cleaned them in vats of cleaning solvents and weak acid solutions. Excellent results were reported. This method should be satisfactory if proper neutralizing solutions are used after the cleaning process. Air blast entraining flyash and other abrasives have also been used.

LUBRICATING SYSTEM

Oil temperatures leaving the bearings should be recorded on the log sheet. This gives a running check on the lubricating-system operation. A gradual increase in this temperature may be caused by (1) rising cooling-water temperature or (2) oil-cooler fouling. An increase in the oil temperature rise through the bearing (temperature difference of bearing and oil-cooler outlets) may be caused by (1) increased bearing loading from a change in alignment (2) increased bearing friction from oil deterioration (3) decreased oil-flow rate (4) partial wiping by dirt entrained in the oil.

These events call for prompt action. Look for steam blowing along the shaft from packing boxes. This steam finds its way into bearing housings and the condensate will deteriorate the oil. The lubricating system must be kept as free from moisture as possible.

TURBINE VIBRATION

An operator accustomed to the natural hum of a turbine can usually detect increased vibration by the change in sound, but he should be equipped with instruments to measure vibration amplitude. Readings should be taken at one point daily, say on the No. 1 bearing, and recorded. When vibration increases occur, take additional readings and prompt steps to locate the cause.

The manufacturer's representative should be called in to investigate when vibrations approach a detrimental magnitude. At least six types can occur:

1. Vibration at running-speed frequency, cause: rub or unbalance.

2. Whipping, a vibration of critical-speed frequency, happens when the unit operates at a speed other than the critical. This form of vibration, primarily caused by oil action in the bearings, can be determined by Frahm indicators.

3. Half-speed frequency vibrations take place when the critical speed is other than about half running speed. A packing rub generally causes it.

4. Double-frequency vibrations on the rotor are of such small amplitude that they are hard to detect. These are caused by difference in flexibility of a 2-pole generator field in a plane through the pole-piece centers and a plane at right angles to it. In 2-pole machines the double-frequency vibration appears in the stator frame when the field is applied. The poles, 180 deg apart, exert a magnetic force on the stator frame tending to distort it into an ellipse. The distortion rotates with the field and the two high and two low points on the ellipse's circumference cause the vibration.

5. Vibrations of very low frequency result from restricted bearing-oil flow.

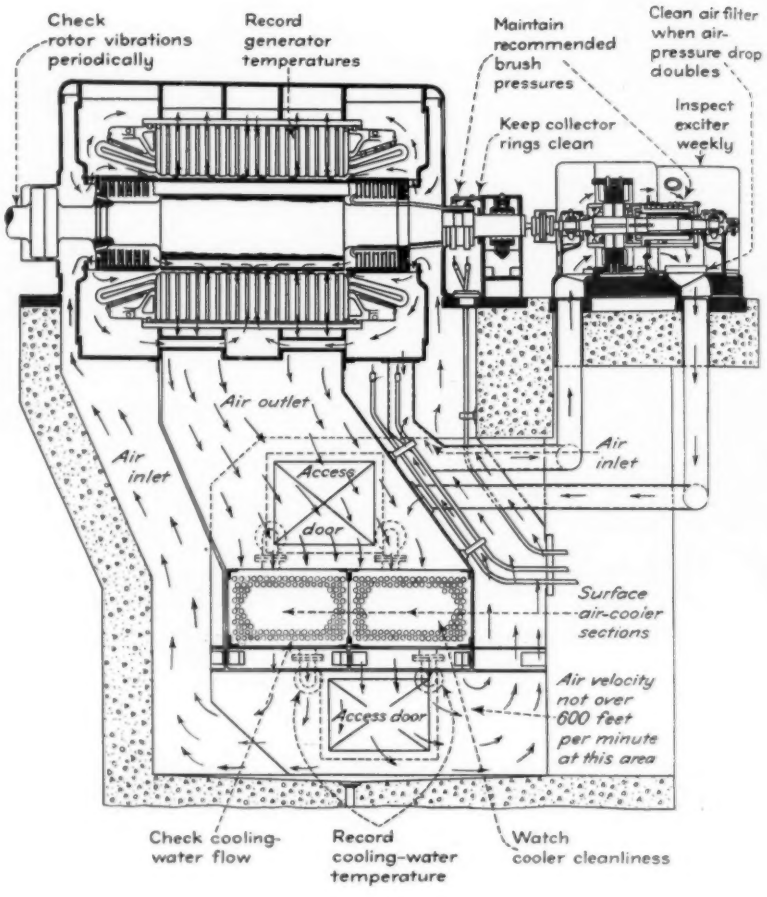
6. The pump-frequency vibrations are caused by incorrectly cut pump gears, or by the gears rubbing on their casing.

Unbalance causes most common vibrations, but balancing does not eliminate the other types of vibrations.

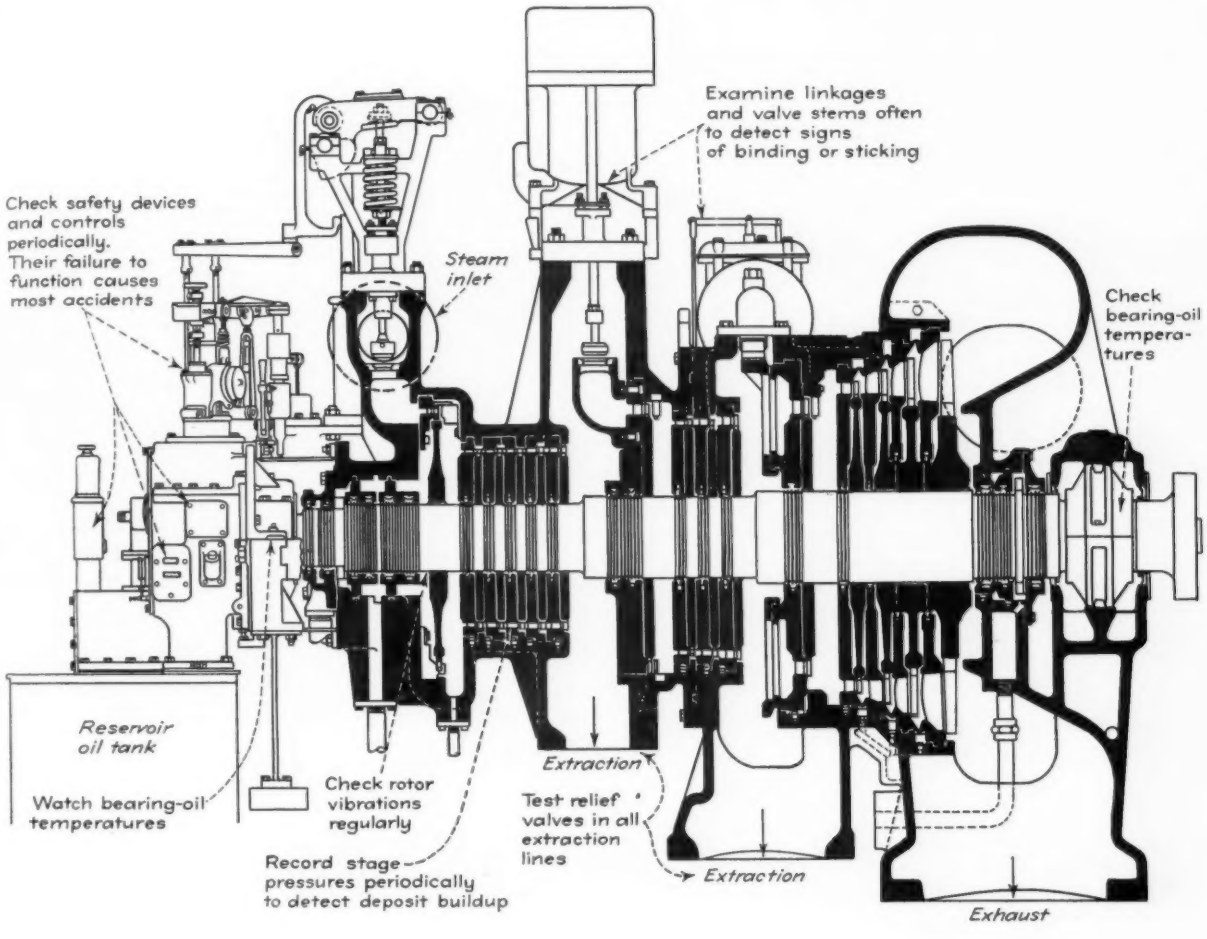
GENERATOR OPERATION

Generator temperatures should be regularly read and recorded. In a closed ventilating system, rising temperatures with a constant electrical load may be caused by (1) reduced cooling-water flow (2) increased cooling-water temperature (3) fouled air-cooler tubes. Steps should be taken to correct rising temperatures before they reach the maximum value allowed by the manufacturer. Most ac generators are designed to operate at the following temperature rises:

ACCESSORIES AND CONDITIONS TO WATCH WHEN OPERATING A TURBINE-GENERATOR



GENERATOR AND EXCITER require as careful followup during operation as the turbine even though mechanical construction is simpler and temperatures lower


Examine linkages and valve stems often to detect signs of binding or sticking
Check safety devices and controls periodically. Their failure to function causes most accidents
Steam inlet
Check bearing-oil temperatures
Reservoir oil tank
Watch bearing-oil temperatures
Check rotor vibrations regularly
Record stage pressures periodically to detect deposit buildup
Extraction
Test relief valves in all extraction lines
Extraction
Exhaust

FREQUENCY OF INSPECTION varies from hourly, for such readings as oil temperatures, to annually or longer when unit is dismantled for internal examination. Here are some vital points to watch, insuring safety and economy

Armature, 60 C measured by imbedded detectors.

Field, 85 C by resistance.

Temperature rises are based on an ambient temperature not exceeding 40 C.

In open-ventilation systems, atmospheric air enters the generator through a screen or filter. Here a gradual rise in generator temperature for the same load and inlet-air temperature indicates that dirt accumulates in air passages.

Keep collector rings clean, and maintain brush pressures within limits specified in manufacturer's instruction books.

Exciters. Most modern exciters are totally enclosed and pipe-ventilated from the main generator, see illustration. The air filter, mounted over the air outlet at the exciter-commutator end, should be replaced when the accumulated dust doubles the pressure drop of the air flowing through it.

Any accumulation of dirt or metal dust inside the exciter housing should be prevented. When fitting new brushes or cleaning the commutator, take special precautions to remove all traces of carbon or copper dust from all parts of the exciter. Compressed air cleans most effectively, but be sure no water is entrained.

Should dirt and dust be lodged with oil, clean it out with carbon tetrachloride and carefully dry the surfaces. Carbon tetrachloride vapor has detrimental effect on commutation, so all traces must be removed before starting the machine. Wipe studs and leads and clean the brush holders to remove all traces of metal dust. See that brushes move freely in the holders. Brush pressure should be maintained within manufacturer's limits, about 3 to 3½ psi of contact surface.

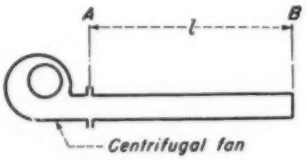
New brushes should be fitted carefully on the commutator. Keep the commutator clean and maintain its polished surface; wipe it occasionally with a piece of hard canvas.

ACCESSORY DEVICES

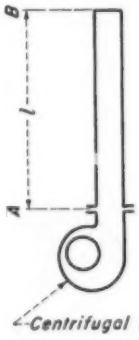
Failure of safety devices to function causes practically all steam-turbine accidents. It is important that these devices be checked periodically to insure their being in working order.

The emergency overspeed governor must be examined and tripped at regular intervals. Whenever a machine is shut down this should be done by the hand trip rather than by manual clos-

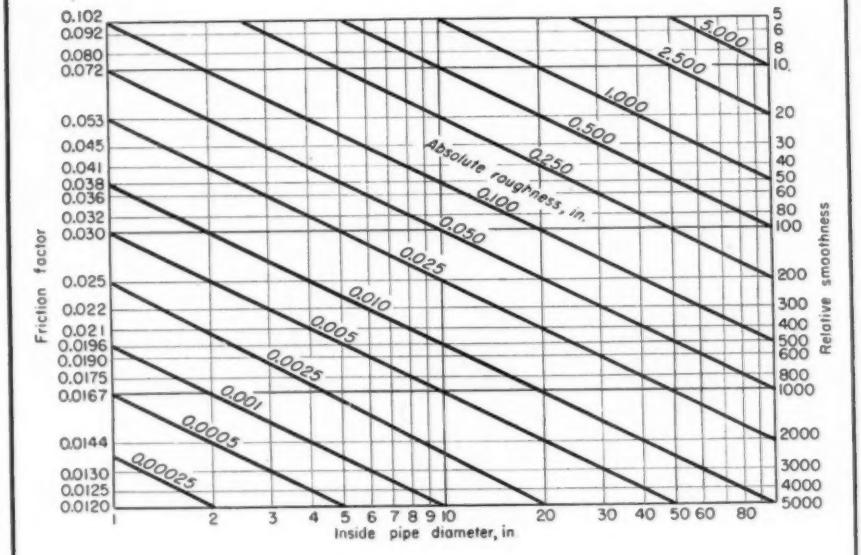
(*Continued on page* 150)



1 With zero air flow, pressure difference in horizontal duct between A and B equals zero



2 With zero air flow, pressure difference in vertical duct from A to B equals air weight



3 For fluids with high Reynolds numbers the friction factor depends only on pipe or duct diameter and absolute roughness as correlated in this air chart

4 Calculating chart for air-pressure drops in piping. Example: For air at atmospheric pressure and 60 F, flowing at a 75-fps velocity through a duct with a relative smoothness of 200, follow the trace and find a pressure drop of 0.031-in. water through distance equivalent to that of one-pipe diameter

How to Determine Reliable Air-Flow

To overcome wide disagreements between air-pressure drops as found on test and as predicted in handbooks, Arthur H Korn here describes method for finding data rationally that may be used with confidence in specifying both duct and fan sizes

▶ DESIGNERS with no experience in laying out specifications for air systems find themselves at a serious disadvantage trying to find reliable basic data. Charts, giving pressure drops for air flow through galvanized pipe and round sheet-metal ducts given in various reference hand-books, differ by enormous amounts. Data on air flow through metal ducts, riveted and lock-seamed, are apparently nonexistent since none have been published.

Absolute roughnesses, Table II, have been calculated from test data compiled by Kemler, but they show too great a range to be really useful. In Kent's *Mechanical Engineer's Handbook—Power*, a diagram for pressure drop in heating and ventilating ducts assumes a constant relative smoothness of 200 regardless of pipe diameter. Mark's *Mechanical Engineer's Handbook* gives a similar chart for velocities between 1200 and 2400 fpm and a constant absolute roughness of about k = 0.006, also regardless of diameter. This seems low since it is at the low end for new steel pipe, Table II. The number of joints generally determines the resistance, and sheet-metal-duct sections are usually only 2½ ft long. The absolute roughness is probably greater than the mean value for the new-steel-pipe range in Table II.

Friction factors, given in *Design of Industrial Exhaust Systems* by Alden, yield pressure drops of only one-fifth to one-seventh of those given by the previous references. These wide discrepancies call for development of a rational approach to the problem.

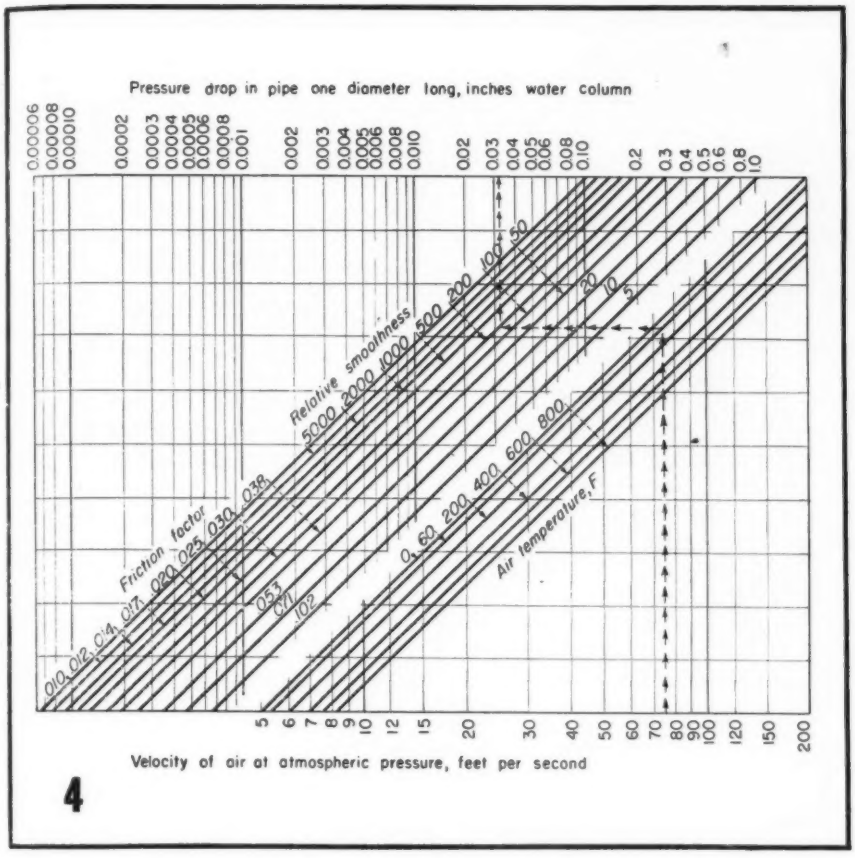
RATIONAL DESIGN BASIS

Pressure loss of a fluid, caused by friction with the pipe or duct through which it is moving, is generally small compared with the fluid's absolute pressure. The general case for a fluid flowing upward in an inclined pipe, forming an angle a with the horizontal, has a pressure drop* of:

$$\Delta p = \frac{dfu^2s}{D2g} + ds \sin a \qquad (1)$$

The last member of the equation repre-

* For equation derivation see "Basic Equations For Fluid Motion And Pressure Drop in Pipes," by A H Korn, *Product Engineering*, May 1947, pp 85-89.



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NOMENCLATURE

a	pipe inclination angle, deg
d	fluid density, lb per cu ft
d_w	water density, lb per cu ft
D	pipe diameter, ft
f	friction factor
g	gravitational acceleration, ft per sec per sec
h	pressure drop, in. water
k	pipe roughness, ft
p	absolute pressure, psia
Δp	pressure drop, psi
R	gas constant
R_n	Reynolds number
r	pipe radius, ft
S	pipe length, ft
t	fluid temperature, F
u	fluid velocity, fps
v	fluid viscosity, lb sec per sq ft

TABLE II—RANGE OF ABSOLUTE ROUGHNESS

Calculated From Test Data

Kind of pipe	Absolute roughness, k, in.
Cold-drawn pipe, brass, copper, lead	0.0005 to 0.0020
New steel pipe	0.003 to 0.018
New cast-iron pipe	0.007 to 0.042

Data for Design of Duct Systems

sents the pressure caused by the weight of a column of fluid of the height, $s \sin a$. It can be neglected for air at atmospheric conditions. Since this pressure difference in a vertical pipe already exists, Fig. 2, before air flow starts, it does not have to be overcome by the fan.

Since $\Delta p = d_w h/12$, equation (1) can be written for air flow as:

$$h = \frac{12dfu^2s}{2Dd_wg} \qquad (2)$$

Gas density depends on its pressure and temperature as given by the universal gas equation, $d = p/R(t + 460)$. Using this relation and transforming (2) to give the pressure drop in a pipe of a length equal to one diameter:

$$h\frac{D}{s} = \frac{6p}{gd_wR} \times \frac{fu^2}{t + 460} \qquad (3)$$

For atmospheric air, $p = 2117$ *psf*, and $R = 53.3$. Water density is 62.43 lb per cu ft, and $g = 32.17$ ft per sec per sec. Substituting these numerical values:

$$h\frac{D}{s} = 0.1186\frac{fu^2}{t + 460} \qquad (4)$$

Friction Factor. The friction factor f varies with air velocity, pipe size, air viscosity, air density and the pipe roughness. These quantities, excepting pipe roughness, are all related to the Reynolds number as in the following:

$$R_n = \frac{Dud}{vg} \qquad (5)$$

TABLE I—RANGE OF REYNOLDS NUMBERS AND VELOCITIES

For Accurate Use With Friction Factors at Atmospheric Pressure and Temperature

Given values of f in second column are valid for Reynolds numbers greater than R_n and for fluid velocities greater than u, below.

If given values for f are used for Reynolds numbers as low as R'_n and for velocities as low as u' the greatest error will be less than E% above true value of friction factor.

Relative smoothness r/k	Friction factor f*	Reynolds number R_n	Fluid velocity, u, fps. Pipe diameter, in. 3	6	12	24	48	Reynolds number R'_n	Fluid velocity, u', fps. Pipe diameter, in. 3	6	12	24	48	E %
15	0.0597	23,500	14	7	4	2	1	6,300	2	2	1	0.5	0.25	20
30	0.0453	53,800	33	16	8	4	2	6,300	4	2	1	0.5	0.25	18
60	0.0356	121,000	75	38	19	9	5	6,300	4	2	1	0.5	0.25	15
120	0.0287	271,000	168	84	42	21	10	16,200	10	5	2.5	1.0	0.5	14
240	0.0237	596,000	370	185	92	46	23	31,600	20	10	5.0	2.5	1.0	13
480	0.0198	1,303,000	808	404	202	101	50	63,000	40	20	10	5.0	2.5	11

* From equation (6)

Variation of friction factor with Reynolds number and roughness is now reliably known for the whole range of numbers generally encountered in industry. Surprisingly, at higher Reynolds numbers the friction factor becomes a constant, independent of the Reynolds number and a function of the relative roughness only:

$$f = \frac{1}{(1.74 + 2 \log r/k)^2} \qquad (6)$$

Limits of applicability for this formula when applied to air at atmospheric pressure and temperature are given in Table I. Instead of using the relative roughness k/r, its reciprocal, the relative smoothness r/k, is used for convenience. Relationship of equation (6) and pipe diameters is shown in Fig. 3.

Finding Design Constants. Gas velocities in exhaust systems usually range from 25 to 80 fps. Higher velocities often cause pressure drops to become so large that single-stage fans cannot maintain desired deliveries. Lower velocities are not desirable either, because they increase duct size unnecessarily and dust particles settle out, adhering to the duct walls. As shown in Table I the friction factors computed from equation (6) can be used for all velocities generally encountered in fan-powered systems.

Greatest possible error that may occur at lower velocities is small in view of other uncertainties, especially the fact that the relative roughness of the pipe is usually not known accurately.

Pipe relative roughness, k/r, on which the friction factor depends, cannot very well be determined by measuring the surface projections k and dividing their mean value by radius r. It is most reliably obtained by finding first the friction factor from test data on high velocity flow, that is, for Reynolds numbers greater than R_n in Table I. Unfortunately, very few such tests are known and usually pertinent facts, such as the kind and number of pipe joints used and information regarding other conditions which influence the pressure drop, are lacking.

The calculating chart, Fig. 4, based on equations (4) and (6) helps to find quickly the pressure drop in a pipe length of one diameter when temperature, velocity and relative smoothness of pipe are known. It shows readily the great variation in pressure drop with the pipe-surface condition and the utter uselessness of any pressure-drop calculation if pipe roughness is unknown.

Available information indicates that absolute roughness rather than relative roughness is about the same for various pipe diameters. For round sheet-metal ducts, such as fan systems use, an absolute roughness of 0.015 appears to be a fair mean value.

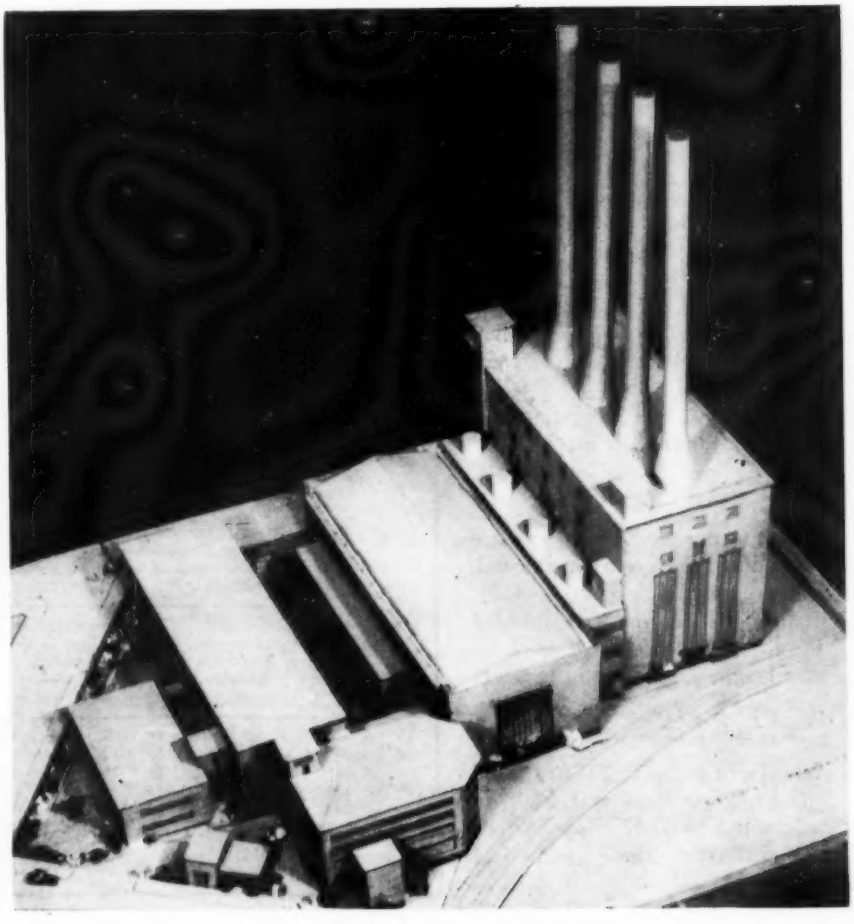
A concerted effort by all those concerned with designing and installing air-duct and piping systems is needed to make available more reliable flow data than are obtainable today. With easily made pressure-drop readings on existing systems and the use of Fig. 3 and 4, roughness factors can be found for ducts of given diameters, materials, and kinds of numbers of joints.

Australian Plant Of Advanced Design

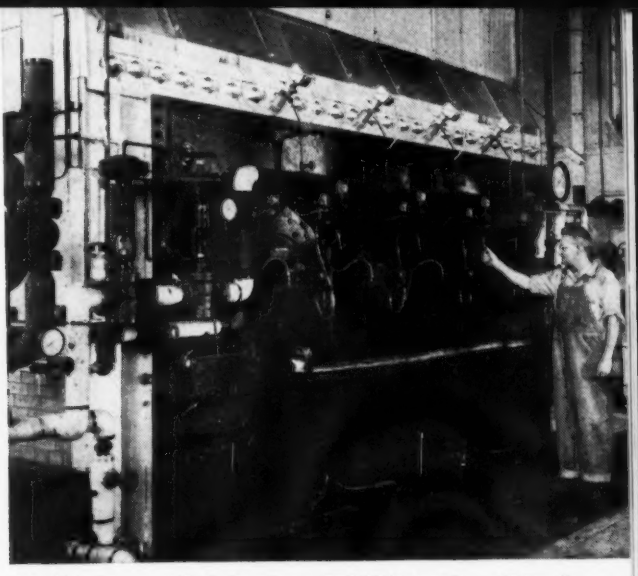
► SYDNEY COUNTY COUNCIL'S new Pyrmont B power station will use the highest steam pressure and temperature in Australia, 1200 psig and 925 F. Now under construction, the plant will ultimately house four generators arranged on the unit system, with steam and feedwater mains interconnected.

Boiler plant will have 430,000-lb-per-hr radiant-type waterwall units with dry-ash bottoms. Economizers and air preheaters are being provided. The steam generators will feed 3-cylinder impulse-type 50,000-kw 3000-rpm turbines driving 3-phase 33,000-v 50-cycle alternators.

The plant will be pulverized-coal fired, with fuel delivered by rail. English firms are supplying most of the principal plant equipment.



ELECTRICITY comes into the plant at 34,500 v; is stepped down to 4160 v in the two 5000-kva transformers comprising the main substation alongside the powerhouse building, above



STEAM is supplied by two 45,000-lb-per-hr oil-fired integral-furnace boilers. Approximately 60% of steam generated is used for process operations

Power for Plastics Production

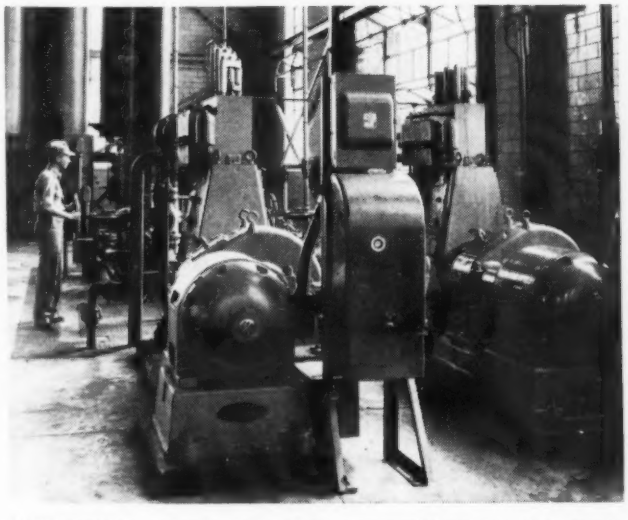
▶ POWER SERVICES play a major role in the complex and closely controlled processes of laminated-plastics manufacture at General Electric's new plant at Coshocton, Ohio, where everything is made, from gears and bearings to insulators and refrigerator door panels.

The single-story plant and the 2-story and basement office building enclose more than 300,000 sq ft of floor space. Here, engineers of the Austin Co, which handled design and construction, have combined many new types of building material and equipment to insure production efficiency.

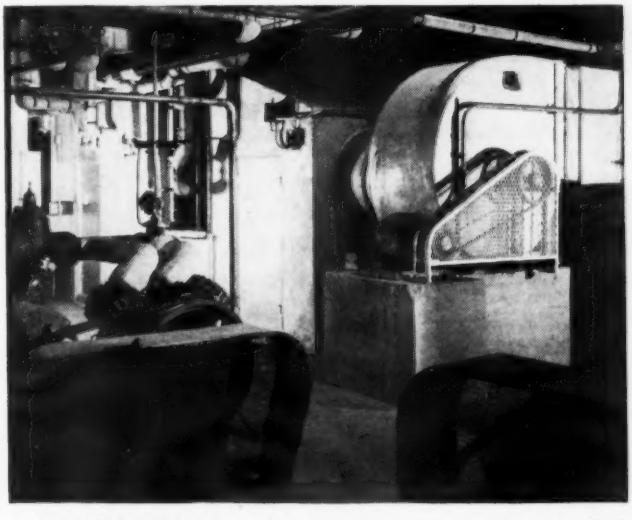
Electrical Equipment. Purchased electricity enters through two 5000-kva 34,500/4160-v transformers supplying four 1000-kva unit substations inside the manufacturing plant, and two 750-kva substations in boilerhouse and varnish building. These deliver 480-v 3-phase current to an overhead-bus distribution system embracing nearly half a mile of plug-in and feeder lines. All smaller transformers are mounted on mezzanines suspended from roof trusses. Varnish house has explosionproof equipment.

Boilers. Boilerhouse at northeast corner of site contains two oil-fired integral-furnace boilers rated at 45,000 lb per hr. These supply steam for the many process uses and to unit heaters for winter heating.

Air Conditioning. Certain process areas, where controlled conditions are important, employ air conditioning and special wall construction. These walls consist of 4 in. of outside common brick, backed by 2 in. of foam-glass insulation, 4 in. hollow tile, and 4 in. glazed tile. Air-conditioning equipment, to maintain 70-F dry bulb and 35% relative humidity, is located on suspended mezzanine platforms.

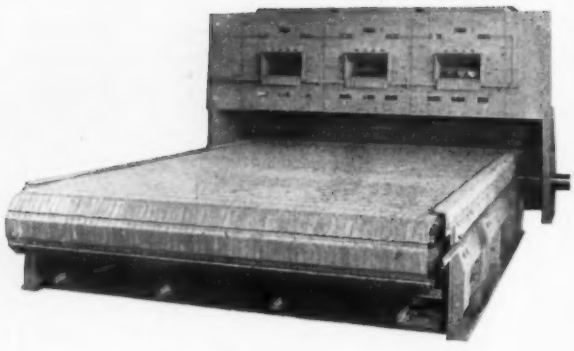


HYDRAULIC pumps and the accumulator in the background maintain 3000-psi pressure for molding presses. Smaller pumps in background serve the 500-psi system



AIR-CONDITIONING equipment serves several controlled-conditions areas where laminating stock is stored and built up for pressing. Total refrigeration load is 188 tons

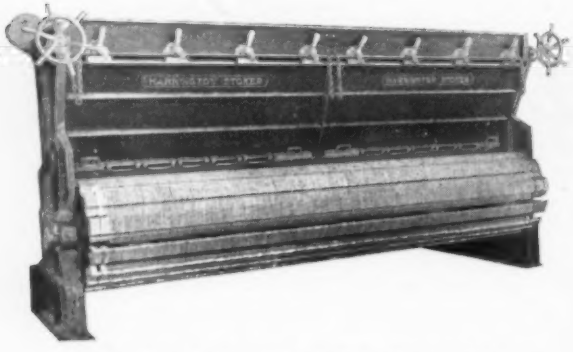
RILEY
any type of



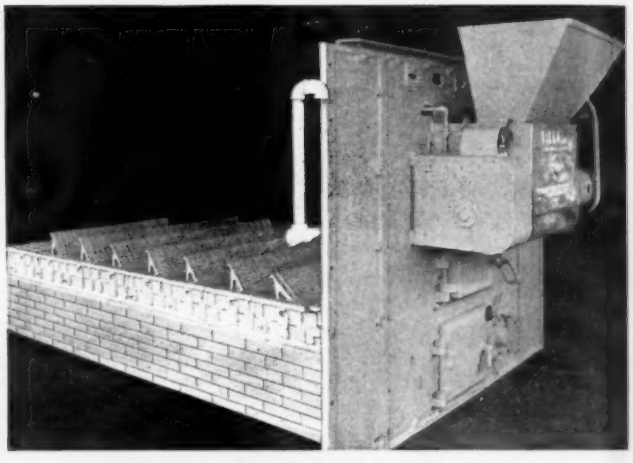
Riley Traveling Grate Spreader Stoker

All Types of Stokers

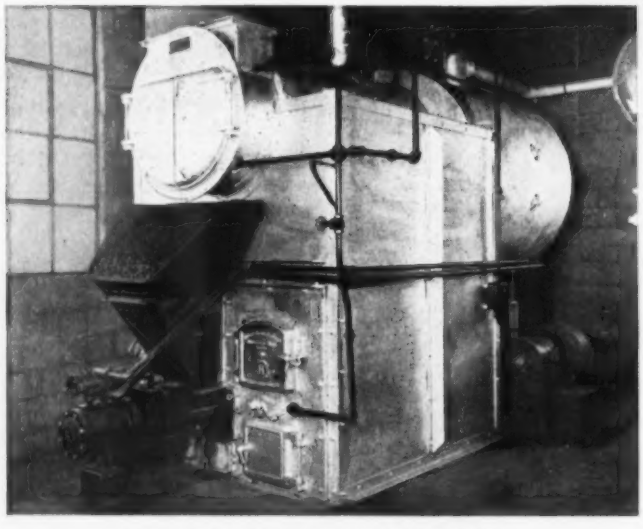
Riley Stoker Corporation manufactures all types of mechanical stoker equipment and is in a position to offer you any type of stoker your particular requirements might dictate, whether spreader stokers, traveling grate stokers or underfeed stokers. There is well over 50 years of stoker engineering experience back of the design of Riley stoker equipment.



Riley-Harrington Traveling Grate Stoker



Riley Dumping Grate Spreader Stoker



Riley Side-dump Underfeed Stoker

Riley Multiple Retort Underfeed Stoker

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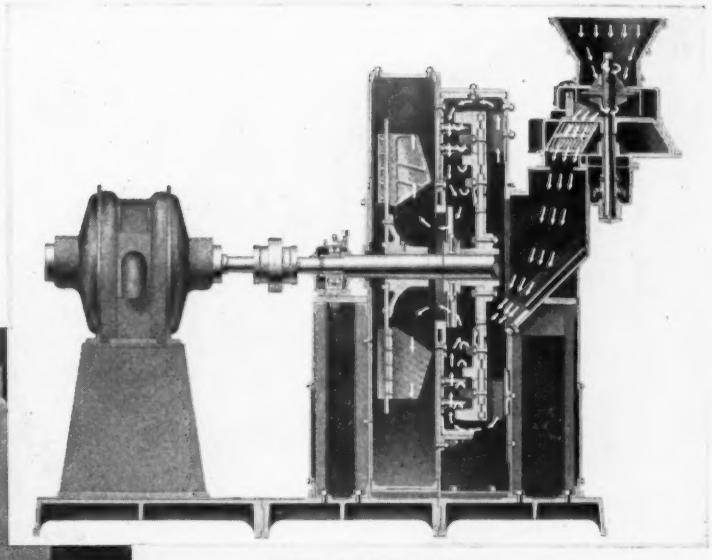
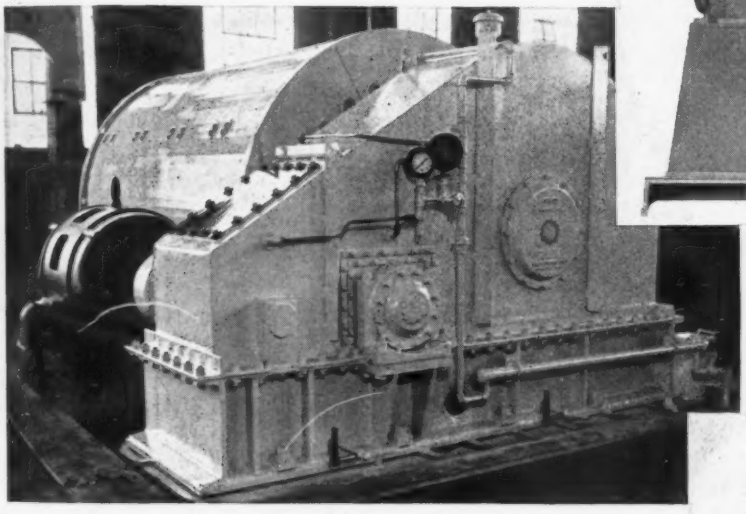
Two Types of Coal Pulverizers

Riley manufactures not only the Riley Atrita Unit Pulverizer, which has been installed in so many of the country's leading power plants, but also the new Riley Ball Tube Mill, so that Riley can now offer you two distinctive types of coal pulverizers. Riley also manufactures pulverized coal burners and combination coal, oil and gas burners.



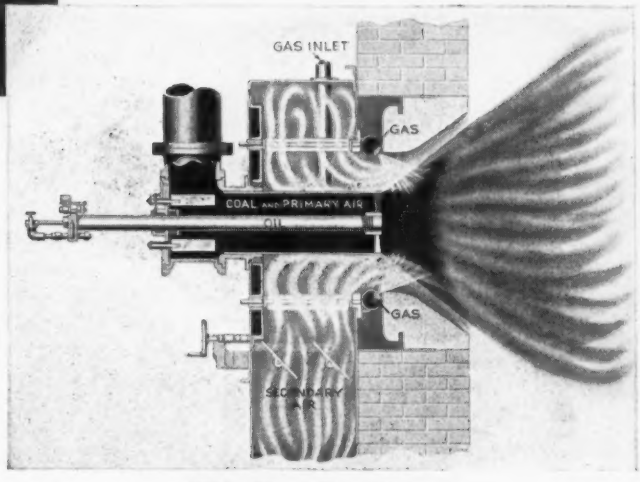
Riley Atrita Unit Pulverizer



Riley Ball Tube Mill

Complete Steam-generating Units

In addition to its complete line of coal-burning equipment Riley also manufactures complete steam-generating equipment, including boilers, superheaters, water-cooled furnaces, air heaters, economizers and steel-clad insulated setting.



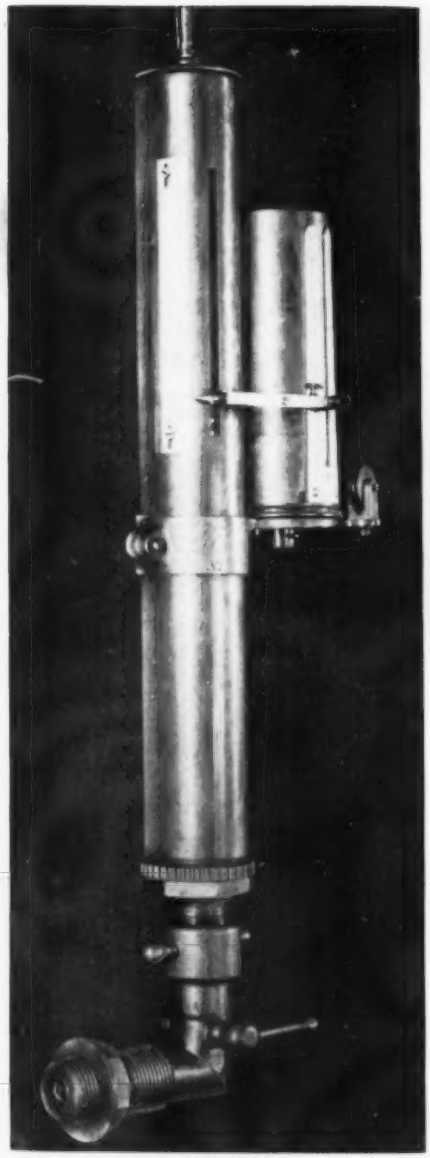
Riley Flare Type Burner

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings and lower costs

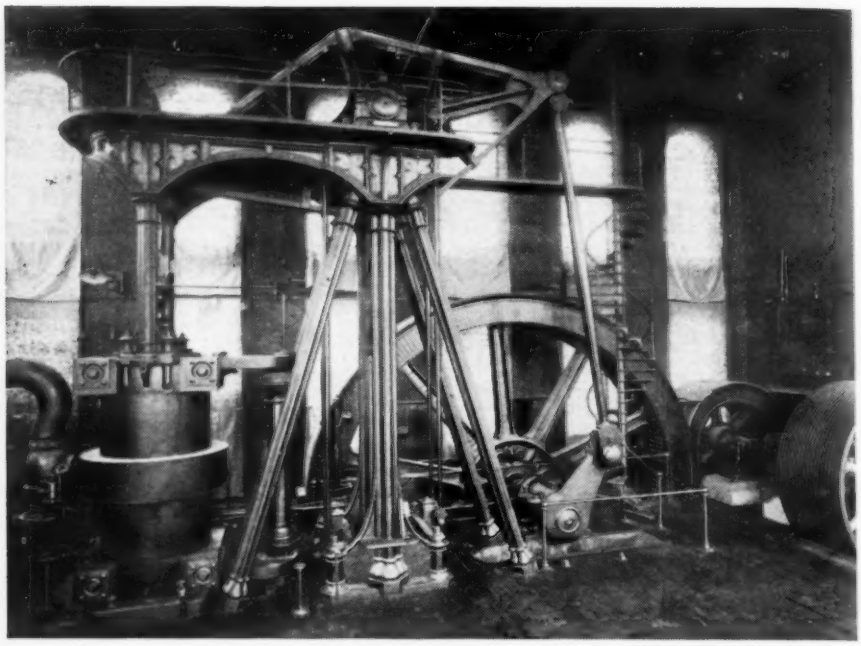
COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

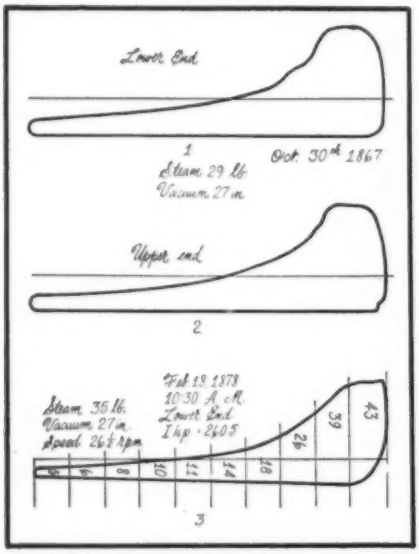


EARLY-MODEL INDICATOR used for first diagrams on walking-beam engine



ANCIENT GIANT produced 500 hp at 26½ rpm on 35-psi steam, 27 in. vacuum

Walking-Beam Engine



INDICATOR DIAGRAMS show engine above produced about 260 ihp, each end

▶ SOME OLD-TIMERS STILL HAVE a fond memory of the power machinery that gave America its industrial start. Judged by today's standards those early steam engines present a weird and unwieldly sight, but they produced many thousands of horsepower before their successors nudged them out completely. Not the least of these old engines is the long since retired walking-beam engine, shown above. It was designed especially for the Plymouth Cordage Co, North Plymouth, Mass.. by E D Leavitt, consulting engineer of Cambridge, Mass. Harrison Loring, City Point works, Boston, Mass., built and installed it in 1867.

Improved Valve Gear. When installed the engine was equipped with slide-valve gear similar to the Green gear. Both the main cylinder and valve gear operated vertically. In 1875, the Sargent Corliss Engine Works of Providence, R. I., replaced the original valve gear and cylinder. The cylinder shown is fitted with the "crab-clam" type valve gear for operating the corliss valves.

The cylindrical pipe behind the *A* frame feeds exhaust steam to jet-type condenser below the floor. The double set of long rods on each side of center post of the *A* frame operates condenser pumps from the walking beam. Condenser-pump valves were flap-type rubber valves fastened on one side.

Sturdy Oldster. Method of holding the hub-end of spokes in their seats is shown in the photo, that is, a tapered key is driven through each spoke. A pin holds the key in place. Flywheel is a wooden toothed gear. Teeth are wooden blocks keyed into openings cast in the flywheel rim. Buttends of teeth can be seen on inside of rim. This gear meshed with a cast-iron pinion on the jackshaft. Rope drive transmitted power from this shaft to the mill.

Indicator-card diagrams 1 and 2 were taken on this engine shortly after it was installed with the ancient-model steam-engine indicator, shown above. No indicated horsepower is available from these diagrams. Diagram 3 was taken with a later design indicator after the original valve gear was replaced with corliss valves. This card indicates about 260 hp on the lower end, which shows this "mountain of iron" produced about 500 hp at 26½ rpm. The cards show that steam pressure varied from 29 to 35 psi, with 27 in. of vacuum.

"The fate of the world sits on this rug"

– JOHN L. LEWIS

NOTE: Paste this editorial in your hat. Re-read it as you start to shiver the next time John L. Lewis cuts off the nation's coal supply.

"Labor monopoly" will mean much more to you then. But if you are worried enough you will get after your Congressman to do his part now — before the shivering starts.

* * *

"The fate of the world sits on this rug."

The men on the rug: John L. Lewis, President of the United Mine Workers, who made the remark; Benjamin Fairless, President, United States Steel Corporation; George M. Humphrey, Chairman, Pittsburgh Consolidation Coal Company; Harry M. Moses, President, H. C. Frick Coke Company; Charles O'Neill, President, United Eastern Coal Sales Corporation; the late John O'Leary, International Vice President of the United Mine Workers; and John Owens, President, District No. 6 United Mine Workers.

The place: Room 800, Carlton Hotel, Washington, D. C.

The time: Last July during the "negotiation" of a new soft coal contract.

The outcome: Another whopping increase in wages and the price of coal, another hike in the cost of living, and a "contract" which binds the United Mine Workers only as long as they are "willing and able to work."

Mr. Lewis was right. The fate of the world did sit on the rug. In fact, it sat at Mr. Lewis' feet, for, as this editorial will explain and as the outcome shows, his power over coal is absolute.

Without coal modern industrial civilization collapses. Without Mr. Lewis' assent coal can not be mined. He has the nation and, in the years 1947-48, the world at his mercy.

The Taft-Hartley Act, good as it is, does nothing to check this kind of monopoly.

I

The Taft-Hartley Act fails to protect the public in many major particulars.

Here are some of them.

1. Labor monopoly is promoted and protected by its continued exemption from the federal antitrust laws. Management has no such exemption and should not have.

2. Industry-wide bargaining, a kind of second-degree monopoly, is left virtually undisturbed. So is union-wide bargaining which extends the power of national unions far beyond a single industry.

3. Featherbedding, the art of getting paid for doing nothing, is left largely intact.

4. The menace of having local utility strikes wreck the health and safety of a community is left untouched. Postponement and persuasion are the only instruments provided to deal with strikes that would wreck the nation.

My purpose in citing these omissions from the Taft-Hartley Act is not to belittle the act or its framers. They did a most courageous and constructive job. They made a real start toward restoring a workable balance in industrial relations in the United States, so far as the law can do it. But they have not completed the job. Among their omissions the two discussed in the next sections of this editorial stand out above all others.

II

The most serious Taft-Hartley shortcoming is its failure to deal with labor monopoly.

Labor monopoly exists wherever a union is so strong that bargaining becomes a sham and the union virtually dictates its own terms.

If an employer or group of employers secures a monopoly or anything approaching a monopoly, prosecution for violation of the federal antitrust laws

is in order. That is as it should be, for monopoly means death to economic and political freedom.

But if a labor union secures complete monopoly control over an industry through control of its workers, that union remains above and beyond the antitrust laws. "The fate of the world sits on this rug." By that imperial attitude John L. Lewis fully demonstrated how obsolete is the notion that labor unions are weak and, therefore, need exemption from the antitrust laws. Through the United Mine Workers, Mr. Lewis controls about 90% of the coal miners. (No company controls more than 5% of the nation's coal output.) Wherever he sits he has at his feet the welfare of the whole nation.

Great international unions exercise a comparable measure of monopoly control in other basic industries—steel, transportation, and automobiles, for example.

These labor monopolies can destroy the nation if they are not themselves broken up. Witness the plight of France. There the Communists have found in the great labor monopolies an instrument for shaking the nation to its foundations.

III

The Taft-Hartley Act also leaves untouched industry-wide collective bargaining, which is a kind of second-degree monopoly.

When all or almost all of the employers in an industry get together with the union leaders to agree on wages and working conditions (that is called industry-wide bargaining) they set up a monopoly control. It is a less concentrated monopoly than when the terms are dictated by either side, as Lewis dictates them in coal. But, nonetheless, competition is eliminated and monopoly control is established over wages, which are by far the largest element in the cost of production. It follows that public regulation of collective bargaining—*which means the end of free unions and free management*—is not far behind.

Some employers defend industry-wide bargaining as their only defense against industry-wide unions. Other employers like it because it makes wages and hours uniform for their whole industry.

For those employers who are forced into industry-wide bargaining in self-defense the road to relief is clear. Congress owes it to them and to the public to free them from the necessity of dealing with a monopolistic union. The best way to do that is to remove the exemption of labor unions from the federal antitrust laws.

To those employers who engage in industry-wide bargaining because they like it the proper answer is also quite clear. They (and the union involved) are maintaining a private monopoly which is offensive to the public interest. It should be prevented by law.

IV

Congress should finish the job of eliminating labor monopoly and industry-wide bargaining.

In the course of enacting the Taft-Hartley law last spring the House acted to eliminate the exemption of unions from the federal antitrust laws and to make industry-wide bargaining illegal. The Senate, however, refused to go along.

The principal reason advanced in the Senate for deferring action was that more knowledge is required to legislate intelligently. To get the needed information, a joint Congressional committee was created.

It is standard Congressional practice to stall off tackling a difficult job by creating a special committee to study it. The new joint committee is not likely to prove an exception to this rule—*unless the voters loudly demand of Congress that it get on with its job of protecting the public interest in the conduct of labor relations—a job which is nowhere near done.*

Helpful and effective as many of its provisions are, the Taft-Hartley Act does not face squarely the central principle of industrial relations in a free society. That principle is this: *Neither employers nor organized workers, separately or in combination, shall exploit the public by establishing a monopoly.*

Do not let your Congressmen go to sleep on the job of solving that problem or hide from it because of fear. The perfect solution may be hard to find. But the problem can be largely solved by making organized labor subject to the federal antitrust laws just as management is now subject to them. If that problem goes by default your children and your grandchildren will really know what slave labor means.

President, McGraw-Hill Publishing Company, Inc.

Hydrogen-Zeolite Treated Water Dissolves Boiler, Superheater Scale

Preliminary experiments using slightly acid water from an ion exchanger for cleaning superheaters led to successful tests on boilers. Amount of salts in raw water is controlling factor

By
THOMAS L B WEBB, *Staff Engineer, Southern Calif. Gas Co, Butadiene Div**
and
JOSEPH D YODER, *Vice-President, The Permutit Company*

▶ REMOVING SCALE and sludge deposits from boilers and accessories with 5% inhibited acid is frequent practice, and its advantages have had considerable publicity. Uninhibited 0.01 to 0.03% acid has also been found very effective in dissolving and disintegrating adhering boiler deposits.

Acid of the latter strength, easily prepared by passing a normal water through hydrogen-zeolite softeners, is not strong enough to make a substantial attack on boiler metal during the short cleaning period. Southern California Gas Co, butadiene div, Los Angeles, Calif., has used the effluent from such a softener for cleaning separately fired superheaters and several boilers.

Softening Process. When regenerated with sulphuric acid, hydrogen zeolite removes calcium, magnesium and sodium cations from water, replacing them with hydrogen. The softener effluent then contains hydrochloric, sulphuric and carbonic acids in proportion to the chlorides, sulphates and carbonates in the raw water. Table I, p 100, gives analyses of the raw water and effluent from the hydrogen-zeolite softener used by this plant.

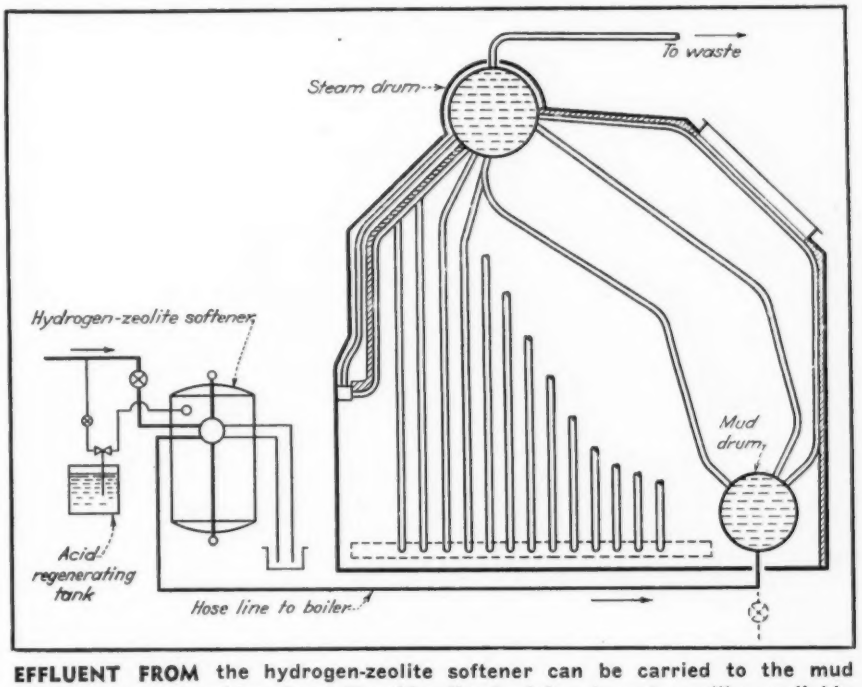
The effluent has a mineral acidity of 145 ppm in terms of calcium carbonate. This compares with an acidity of 50,000 ppm for a 5% acid solution, commonly used with an inhibitor for boiler cleaning. Acidity from a hydrogen-zeolite softener remains constant for any given raw water so there is no problem of mixing concentrated acid with water.

Cleaning Superheaters. First application of hydrogen-zeolite treated water was for cleaning a separately fired hair-pin-type superheater, in October 1944. Up to that time there had been no established practice for cleaning these units other than to use distilled water. This is a slow and costly process.

For the first job, water from the hydrogen-zeolite softener was delivered to the superheater at a rate of 10 gpm for approximately 45 hr. Water entered the inlet header at a pH of 2.6, and cleaning was continued until the pH of superheater discharge was about 4.4. Table II indicates the rate at which solids were picked up. Initial discharge from the outlet header was high in total solids and had a pH greater than 11. As washing progressed, total dissolved solids and pH decreased, an indication of cleaning progress.

Present cleaning method is to pass hydrogen-zeolite treated water through the superheaters at 22 gpm for 6 to 8 hr, or until pH of the discharge is about 4.4. Diagram on p 101 shows total solids and pH of water leaving the superheater tubes from the start to the end of a normal cleaning operation. As indicated, it requires over 2½ hr to fill the superheater tubes at 22 gpm. After acid washing, each tube is rinsed with city water at 40 psi for 2 or 3 min.

Effects of Cleaning. When new, the superheater-tube temperature for normal operation was 740 to 750 F. After 5 months' operation scale or deposits increased the tube temperature to 760-790 F. After cleaning with hydrogen-zeolite water the average temperature drops to 680-760 F. This is substantially lower



EFFLUENT FROM the hydrogen-zeolite softener can be carried to the mud drum through a rubber hose if rubber-lined piping is not readily available

* T L B Webb is now field engineer in Los Angeles, Calif., for The Permutit Company.

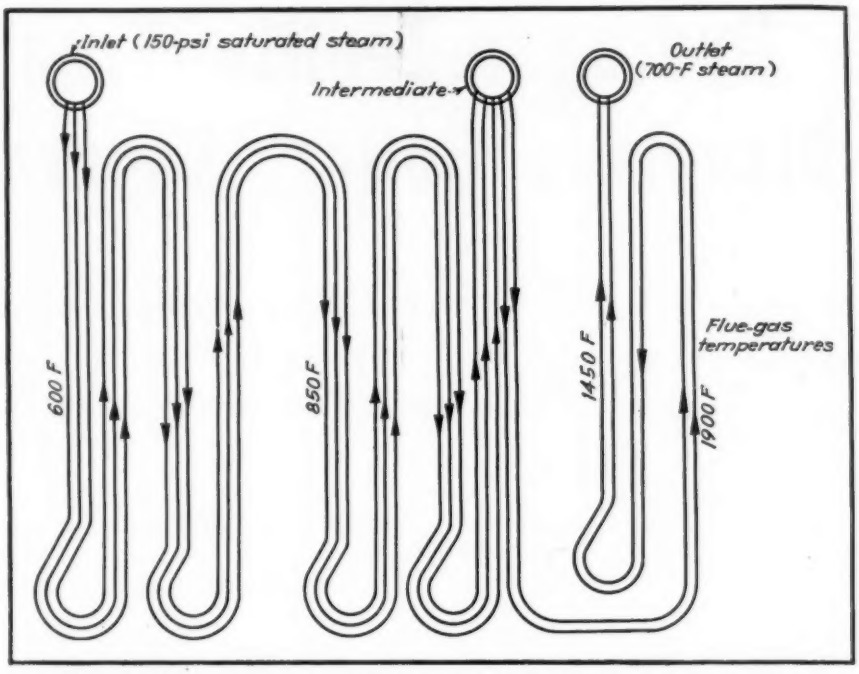
than average when the tubes were new, and is probably the result of removing some of the mill scale during cleaning operations.

The hydrogen-zeolite water softener at the plant of Southern California Gas Co requires approximately 6½ lb of 93% H_2SO_4 per thousand gal of water treated. At a cost of 1½¢ per lb of H_2SO_4 this represents a chemical cost of 10¢ per thousand gal, or a total acid cost of 80¢ for one cleaning. Considering equipment cost, depreciation, taxes, operation, etc, hydrogen-zeolite treated water costs 20¢ per thousand gal. On the basis of 8000 gal of water used, cleaning costs $1.60, plus the labor of piping to and from the superheater.

Use on Boilers. The method proved so successful that the company decided to try the same procedure on several B&W 70,000-lb-per-hr 150-psi integral-type saturated-temperature boilers.

No. 1 boiler in No. 2 plant was opened after 10 months' service, during which time it had not been supplied continuously with properly softened water. Scale in the tubes appeared to be a mixture of hard sulphate and soft carbonate, and was about ⅛ in. thick.

Hydrogen-zeolite treated water was introduced through the mud-drum blowoff line and was discharged from the top of the steam drum without removing internal fittings, as on p 99. Water flow was continued for 12 hr at 22 gpm, or until the pH of the discharge was about 4.4. After cleaning, the boiler was drained and rinsed with water from the sodium-zeolite softener, which has an alkalinity of 193 ppm, Table I. Other units in the plant have been cleaned the same way, and the method is now standardized as the most practical, economical way to clean the boilers and accessories in this plant.



CLEANING HAIRPIN-TYPE SUPERHEATERS with distilled water is both slow and costly by the usual practice. Effluent from ion exchanger does a good job

External Cleaning. Hydrogen-zeolite water is also useful for externally cleaning boiler headers where mineral solids accumulate at handholes. These solids, of the same constituency as those in the concentrated boiler water, are chiefly sodium salts deposited where leaks occur through gasketed handhole openings. The deposits, containing considerable alkali, are quickly removed with hydrogen-zeolite water. After cleaning, the boiler header is rinsed externally with city water from a pressure hose.

Following the successful experience of Southern California Gas, the City of Los Angeles used the same method for washing out their 500,000-lb-per-hr 1200-psi boiler at Harbor Steam Plant. This unit, regularly fed with condensate from surface condensers and evaporator makeup, was filled with water from a hydrogen-zeolite softener and allowed to stand overnight. It was then drained and rinsed with city water. The dilute-acid treatment dissolved some solids while the remainder were disintegrated and easily removed by rinsing with water under pressure from a hose.

Southern California Gas Co has washed a total of 9 boilers with hydrogen-zeolite softened water. Of these, 7 were cleaned with cold water and 2 were treated with partly heated water. For heating, a small pilot fire was ap-

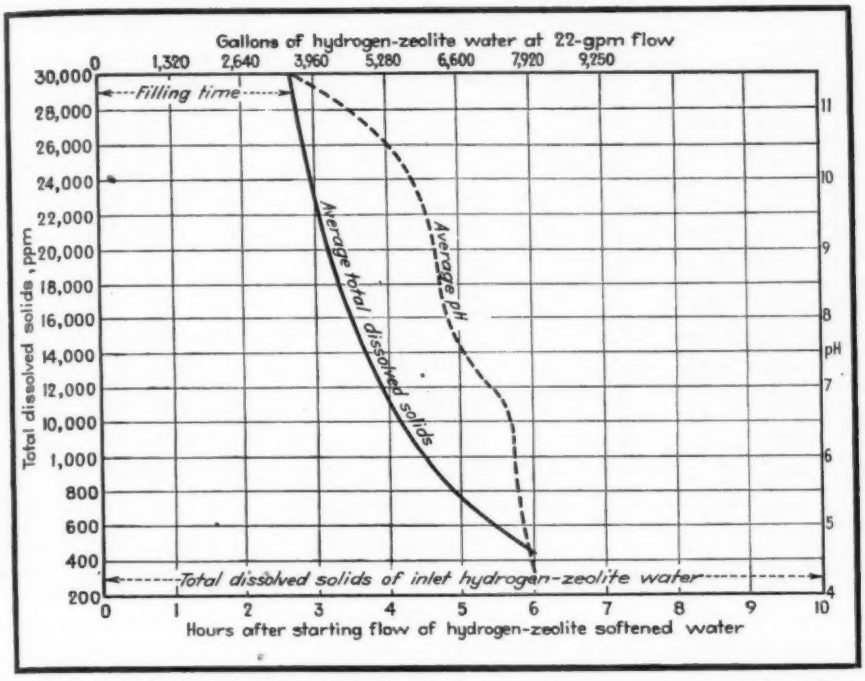
TABLE I—EFFLUENT FROM SODIUM AND HYDROGEN SOFTENERS

Constituents	Raw water	Effluent water: Na_2Z	Effluent water: H_2Z	Mixture: 51% H_2Z 49% Na_2Z
Total Hardness	260	3	3	3
Calcium	162	2	2	2
Magnesium	98	1	1	1
Sodium	98	355	17	182
Hydrogen	0	0	145	0
Total Cations	358	358	165	185
Bicarbonate	169	169	0	20
Carbonate	24	24	0	0
Chloride	47	47	47	47
Sulphate	118	118	118	118
Total Anions	358	358	165	185
Carbon dioxide	0	0	160	143
pH	8.4	0	2.6	5.5

TABLE II—EFFLUENT FROM SUPERHEATER TUBE DURING FIRST CLEANING WITH WATER FROM THE HYDROGEN-ZEOLITE SOFTENER

Characteristics	Hours after starting wash: 16	24	41	45
Total solids calculated, ppm	17,000	1,870	750	438
Conductivity in michromhos	20,000	2,200	865	525
M O Alkalinity, ppm	1,682	104	104	1
Silica, SiO_2, ppm	40	36	18	21
Phosphate PO_4, ppm	40	13	0	0
pH	10.7	6.3	6.3	4.4

Note: There were interruptions at the start so that it was 16 hr before the boiler was filled to overflowing. Frequent tests were made but only these few recorded.



TOTAL DISSOLVED SOLIDS AND pH of the overflow, after required filling time of 2½ hr, continues to fall at fairly uniform rate until cleaning stops

plied, sufficient to form a slight steam pressure. Heating caused a more rapid reaction and should be especially helpful when boilers are badly scaled. No detrimental effect was noticeable on the boiler metal regardless of whether cleaning solution was at room temperature or heated slightly.

Laboratory Tests. After successfully cleaning a number of boilers with hydrogen-zeolite treated water, it appeared advisable to observe the possible effect on boiler metals by laboratory tests. Tables III and IV summarize the results.

Test coupons, 1 by 4 in., cut from boiler tubing, were sandblasted to remove rust, scale or other coating that would protect the metal from exposure to acid solution. Half the coupons were stressed by bending one end 90 deg. There was no substantial difference in the rates of corrosion regardless of whether the coupons were stressed or not. All averages of results in Tables III and IV were obtained from 50% stressed and 50% unstressed coupons. The free mineral acidity of the treated water was substantially as reported under column 3 of Table I, or about 145 ppm in terms of calcium carbonate. The inhibited acid was a 5% hydrochloric (HCl) solution using 0.2 cc of inhibitor for each 100 cc of acid.

Hydrochloric acid has been more effective (POWER Sept, Oct, 1946) than sulphuric for cleaning boilers because the end product, calcium chloride, is highly soluble, whereas the end product of sulphuric acid with calcium carbonate, calcium sulphate, is relatively insoluble. Formation of calcium sulphate interferes with the penetration of sulphuric acid solution through the scale.

When using a dilute acid, comparable in strength with that from a hydrogen-zeolite softener, hydrochloric or sulphuric acids are equally satisfactory. Sulphates in the raw water and, therefore, in the effluent from a softener are not high enough to produce an insoluble product of calcium sulphate.

Tables III and IV show comparative rates of corrosion of the test coupons when using stationary hydrogen-zeolite treated water as compared with stationary 5% inhibited acid at room temperature. Comparing columns 1 and 2 of Table III shows that the rate of corrosion with hydrogen-zeolite water is only about 50% of that with 5% inhibited acid.

Heating Test Samples. If the hydrogen-zeolite treated water is heated to 200 F, however, its rate of corrosion is then about twice that of 5% inhibited acid at 72 F. Corrosion rate of the inhibited acid at 200 F was only half its rate at 72 F. One explanation for this peculiar behavior is that the higher temperature accelerated the inhibitor's effectiveness. Results here do not agree with practical experience in cleaning boilers with inhibited acid because temperatures of 200 F have been reported to cause substantial corrosion. *Instructions for cleaning boilers with inhibited acid normally call for a maximum temperature of 160 F.*

Because laboratory tests showed a rate of corrosion with hydrogen-zeolite water about four times as great at 200 F as at 72 F and, considering that the boiler deposits reacted readily with cold dilute acid, it was decided to follow a regular procedure of using hydrogen-zeolite water at room temperature for boiler cleaning.

Subjecting a boiler to reaction with hydrogen-zeolite water for a 12-hr period does not imply that the acidity in contact with the metal always has a pH of about 2.5. The dilute acidity is immediately neutralized as it reacts with the calcium or magnesium carbonate so that, for a greater part of the time, water leaving the boiler is definitely on the alkaline side. It has been found practicable to stop cleaning when water leaving the boiler is at about pH 4.4.

(*Continued on page* 140)

TABLE III—RESULTS OF TESTS 1 AND 2

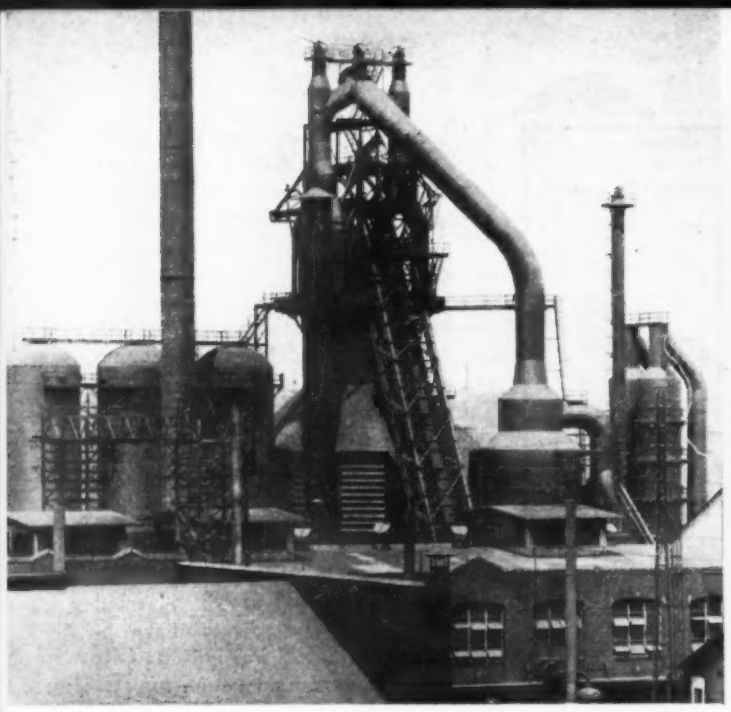
Stationary water, temperature 72 F.
Hydrogen-zeolite treated water 0.015% vs inhibited acid.

	—Avg loss in 24 hr for 18 tests— Hydrogen-zeolite water	5% inhibited acid
Weight, lb per sq ft per day...	0.0034	0.0064
Thickness in inches per day....	0.00041	0.00077
% in wall thickness per day....	0.026	0.50

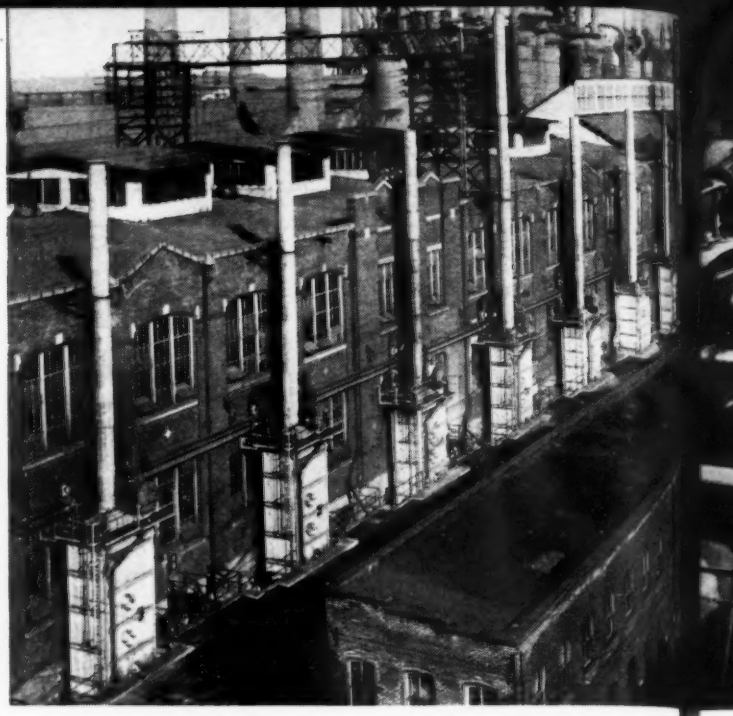
TABLE IV—RESULTS OF TESTS 3 AND 4

Stationary water, temperature 200 F.
Hydrogen-zeolite treated water 0.015% vs 5% inhibited acid.

	—Avg loss in 24 hr for 4 tests— Hydrogen-zeolite water	5% inhibited acid
Weight, lb per sq ft per day...	0.0136	0.0029
Thickness in inches per day....	0.00164	0.00035
% in wall thickness per day...	0.107	0.023

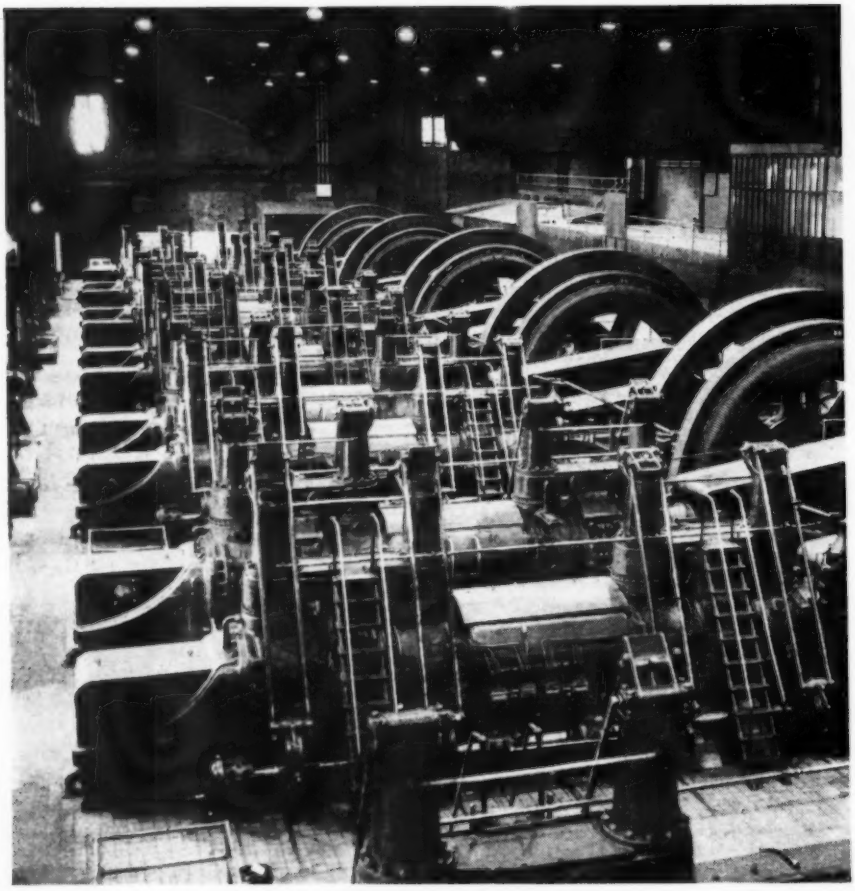


BLAST-FURNACE GAS leaves furnace (center) at top by downcomer, large-diameter pipe, to dust catcher (below)



WASTE-HEAT BOILERS, outside the engine house, receive exhaust from engines fired by blast-furnace gas

How Gas Engines Serve Today's

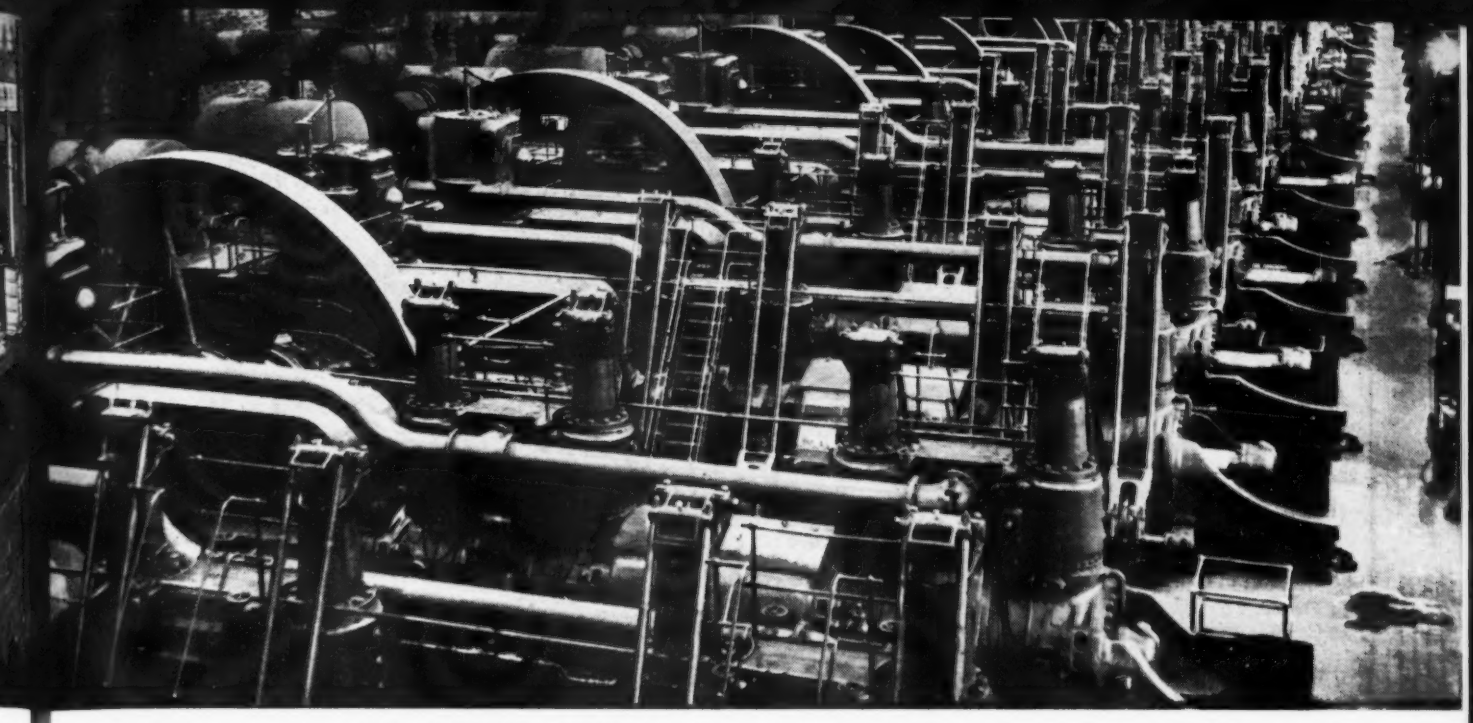


ROUGHLY 20% OF PLANT ELECTRICAL LOAD comes from gas-electric 25-cycle engines at 25% thermal efficiency including pickup from waste-heat boilers

A one-time major source of steel mill power now shares the kw load. W M Cline Jr, combustion engineer, Bethlehem Steel Co, tells how typical steel mill uses gas engines to advantage, gives operating and heat-balance details

▶ STEEL MILLS, with gas-electric engines installed, find their continued use an operating advantage. A combination of gas engine with a waste-heat boiler, working from the engine exhaust, produces power at a rate of 9400 Btu per kwhr. This includes a credit of about 2 to 4 lb of steam per kwhr developed in the waste-heat boiler. Without this recovery thermal efficiency runs about 25%, or 13,600 Btu per kwhr.

A typical steel plant today requires about 65,000,000 kwhr per month. Gas engines already on the line supply about 20% of this load, with the remainder split roughly between purchased power and steam-generated energy. This division of load has come



BATTERY OF GAS-POWERED BLOWING ENGINES furnish heated air in volumes up to 100,000 cfm at 20 psi. Air requirements for blast furnaces are shared by some steam turbine-driven blowers to give a flexible supply source

Steel Mills

about from changes within the steel industry.

For instance, in the early days the gas engine enjoyed the favored spot as prime mover in the steel mill. This was so because (1) plant electric loads were small, individual steam drives common for most equipment (2) blast-furnace gas-fired boilers suffered from using raw gas without cleaning (3) smaller quantity demand of the individual gas engine permitted cleaning gas without too heavy a capital outlay (4) efficiency of the current gas engine ran 1½ to 2 times that of the contemporary steam engine and boiler installation (5) capital costs for gas engine and equivalent steam boiler and turbine were about even.

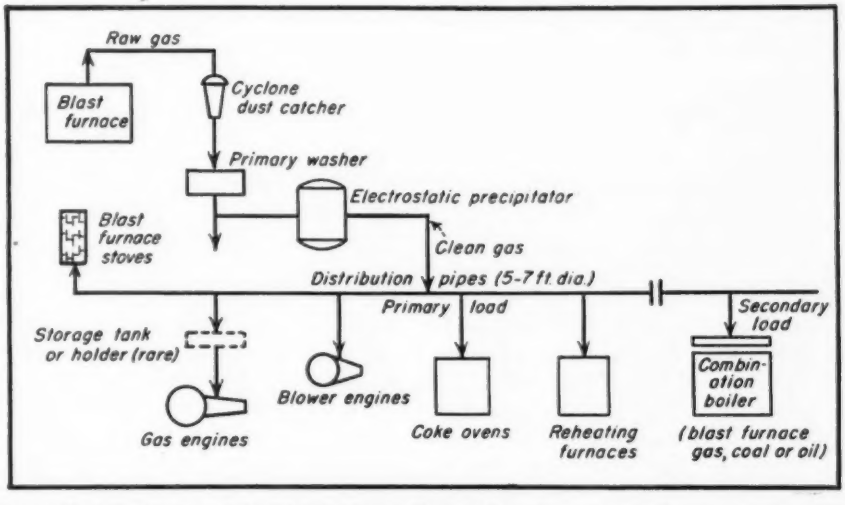
Today's Gas Engine. Since 1930 the picture has changed. Gas-electric engines have lost ground to newer condensing and noncondensing steam turbine-generators. The reasons are (1) enormous electrical load growth within the plant making large-capacity turbines justifiable (2) increase in reliability and efficiency of blast-furnace gas-fired boilers at higher operating pressures (3) decrease in capital investment for steam stations to the point where they run about half that of an equivalent engine installation (4) transition to 60-cycle power, which rules out the gas engine because of size requirements (number of poles in generator) and speed (present speed runs about 88 rpm) (5) advent of the topping turbine that permits use of higher-pressure higher-temperature steam in this unit and its exhaust to existing lower-pressure condensing machines, or direct to process.

Operating Characteristics. Now let's look at a typical gas engine. Speed is based on frequency of the electric current produced and number of poles in the generator field. With a current requirement of 25 cycles and a machine with 34 field poles, engines must operate at $25 \times 60 \div 34/2$, or 88.24 rpm. This speed is critical because the gas engines are synchronized with other units and purchased power supply from utilities.

Governing for speed control consists of a pilot-operated hydraulic cylinder mechanically tied into the gas-regulating valve. A centrifugal or flyball governor operates the pilot valve, which admits oil under 45 to 50 psi to the cylinder. A pump driven off the engine camshaft develops the hydraulic pressure.

A spring-loaded overspeed trip attached to the flywheel cuts off ignition if flywheel exceeds a preset speed.

Starting up and putting an engine under load involves a somewhat stand-



DISTRIBUTION OF BLAST-FURNACE GAS within the mill follows chart with certain loads given first call, and blast-furnace gas boilers as "flywheels"

TABLE I—PHYSICAL CHARACTERISTICS OF TYPICAL 2500-KW STEEL-MILL GAS ENGINE

ENGINE END	
Floor space occupied by one unit	2400 sq ft
Height above floor (over flywheel)	18 ft, 4½ in.
Number of cylinders	4
Cylinder size	47-in. dia x 60 in.
Crankpin	22-in. dia x 16 in.
Crosshead pins	15-in. dia x 17 in.
Main bearings	30-in. dia x 54 in.
Shaft dia at center	36 in.
Flywheel dia	28 ft
Cooling water	18,500 gph
Gas consumption (normal load)	435,000 cfh
Thermal efficiency (less waste-heat-boiler)	26.0%
Complete engine, wt (including flywheel)	1,500,000 lb
Frame, wt	167,000 lb
Cylinder, wt (without valves or gears)	35,000 lb
Connecting rod, wt	14,000 lb
Shaft, wt	72,000 lb
Shaft, wt (with cranks and wheel hub)	196,000 lb
Main crosshead, wt	11,000 lb
Piston, wt	3600 lb
Piston rod, wt	7400 lb
Flywheel, wt	260,000 lb
GENERATOR END	
Field poles, number	34
Rating at 0.8 pf, continuous	2500 kw
Current	25 cycles, 3 phase, 6600 v
Efficiency (full load)	95%
Rotor, wt	65,000 lb
Complete generator, wt	134,000 lb

ard procedure. Time required to bring an engine up to load hinges on the length of time it has been off the line as well as number and type of repairs made while it was out of service. As an example, some repairs require "running-in" time and an engine may be run for as much as 20 to 30 min for this operation before having any load put on it. Again, if an engine has been down some time and all parts are cold, allowance must be made for heating it up so difficulties from uneven expansion can be avoided. Cast-iron liners covered with a layer of insulation and housed in steel shells act as the exit channel for exhaust gas from the engines. They undergo considerable expansion and growth in starting up so allowance must be made for this action.

Normally, starting up with a warm engine takes less than 5 min. Compressed air at 250 psi admitted through cam-operated air-starter valves turns the engine over. During this turning-over period gas is gradually introduced until a combustible mixture is available. After it is in the cylinders, the compressed-air supply goes off and engine is brought up to speed under manual control with visual guidance from a synchroscope. Once it indicates the engine is up to exact speed the generator is put on the line.

Load scheduling for these engines is made on their duty as base-load units. They can carry reduced loads but within definite limits. With steam turbines also delivering energy the usual practice is to take advantage of the turbine's better ability to follow any load variation.

Engine exhaust passes through cast-iron liners, and enters waste-heat boilers. Exhaust-gas temperature entering the boilers runs about 1200 F. These are vertical watertube units equipped with economizers and superheaters, capable of reducing engine exhaust from 1200 to 350 F. Some deliver steam at 165 psi, others at 275 psi, with capacities from 2 to 4 lb per kwhr.

Feedwater for the boilers acts first as a cooling agent for pistons, cylinder jackets, cylinder heads and exhaust valves. About 18,500 gal per hr pass through the engine to experience a temperature rise of about 60 F. This heat pickup is credited to the engine in computing its thermal efficiency. Table II gives a typical heat balance from a paper by T A Lewis, superintendent, service div, Bethlehem plant, Bethlehem Steel, presented before the Association of Iron and Steel Engineers.

A definitely scheduled maintenance program is carried out for all gas-electric engines. It consists of a shutdown about every 600 hr to check bearings, piston-rod alignment, cylinder lubrication, generator clearance, etc, and to flush cooling-water jackets.

TABLE II—HEAT BALANCE Typical Gas Engine and Boiler

	M Btu	*Percent*
Net power generation	12,683	27.16
Steam generation	13,983	29.94
Loss to cooling water	12,040	25.78
Loss to boiler blowdown	913	1.95
Loss to sensible heat in stack gas	4,691	10.04
Loss to CO in stack gas	—	0.00
Radiation and unaccounted for	2,398	5.13
	46,708	100.00
Boiler Heat Balance		
Steam generation	13,983	70.51
Loss to blowdown	913	4.60
Loss to sensible heat in stack gas	4,691	23.66
Radiation and unaccounted for	243	1.23
	19,830	100.00
Engine Heat Balance		
Net power generation	12,683	47.18
Loss to cooling water	12,040	44.80
Radiation, mechanical and electrical losses	2,155	8.02
	26,878	100.00

VERTICAL TURBINE PUMPS

Q&A

W C Mumford, application engineer, vertical turbine-pump division, Worthington, gives practical information on construction, operation, characteristics, troubles, remedies

1—Service, Drives, Construction

Q 1—What is a vertical-turbine centrifugal pump?

A—It is a vertical-shaft, diffuser, single- or multi-stage centrifugal pump with the pumping element suspended from the discharge piping, Fig. 1 and 2. Needs of a given installation determine length of discharge piping. Pumping bowl, *B*, may connect directly to the discharge head, as in close-coupled pumps for shallow pits or sump service. Under such conditions there may be no discharge piping.

These pumps, originally designed for raising water from wells, have been variously known as deepwell, turbine-well or borehole pumps. Vertical-turbine pump is now the accepted term.

Q 2—What is the difference between a vertical-turbine pump and vertical wet-pit propeller pump?

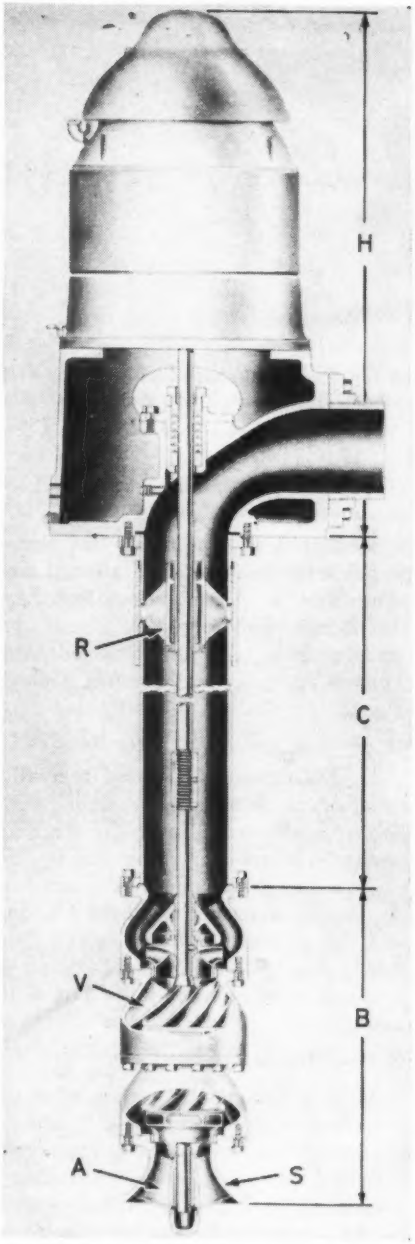
A—The basic difference between these units is specific speed. Although there are generally no limitations, vertical-turbine pumps are of medium specific speed and wet-pit propeller pumps of high specific-speed design.

Vertical-turbine pumps are suitable for installation in cased wells; by multi-staging, heads as high as 1000 ft can be obtained.

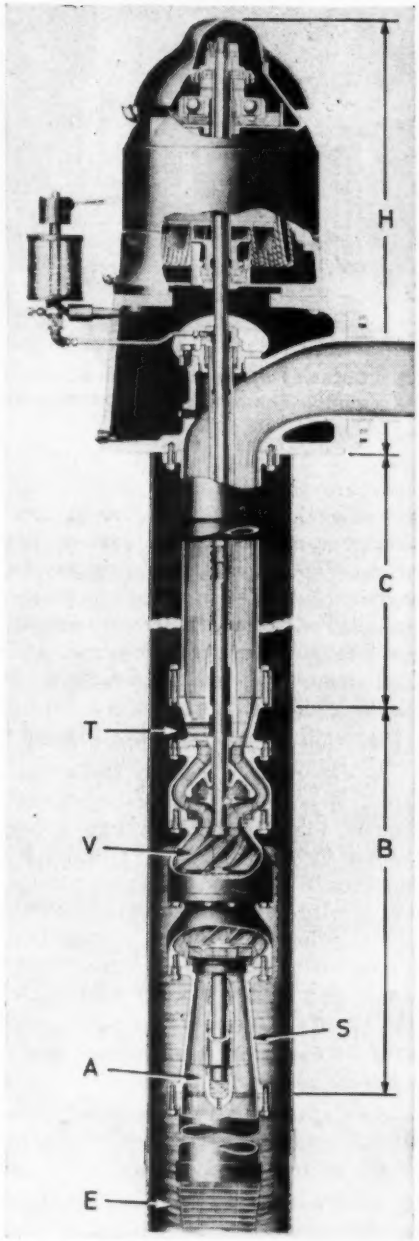
Vertical wet-pit propeller pumps are used for open-pit or sump service. For the same capacity and operating speed their head per stage is lower than that of a comparable vertical-turbine pump. Although single-stage pumps predominate, two stages are often used and sometimes three stages are required to meet heads below the range of a vertical-turbine pump. They are usually called wet-pit propeller pumps and have either axial-flow or mixed-flow impellers.

Q 3—In what services are vertical-turbine pumps used?

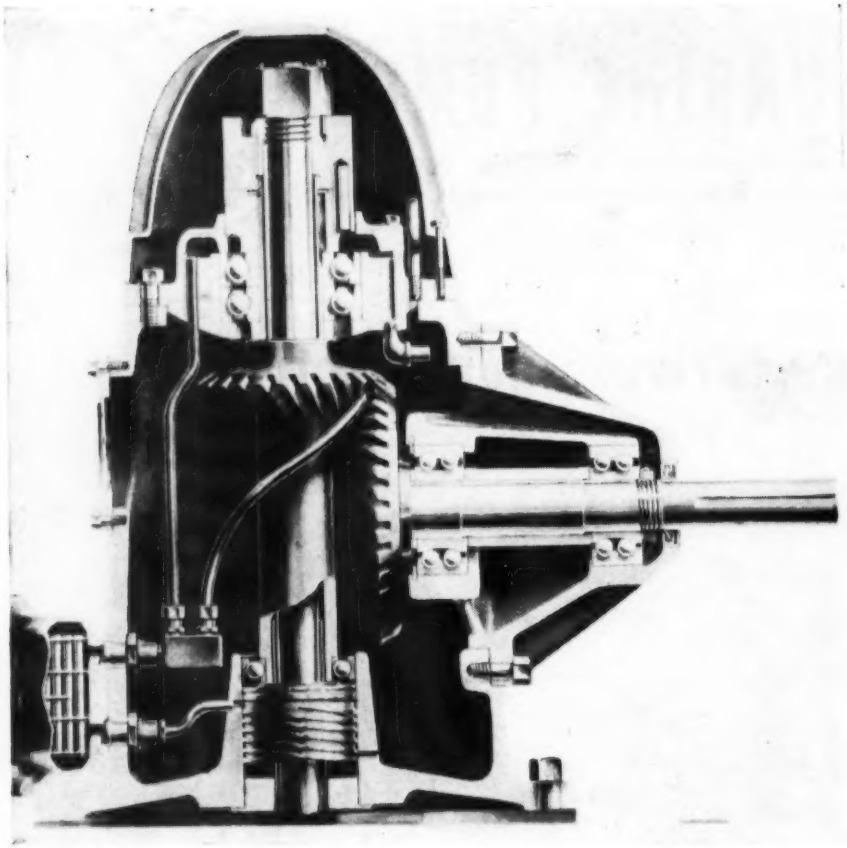
A—Pumping from wells constitutes their largest field of applications, but



1 Motor-driven, vertical-shaft, diffuser, multistage, deepwell centrifugal pump has pumping element suspended from the discharge piping



2 Vertical-shaft turbine deepwell pump has discharge opening above the foundation and driving shaft enclosed in a tube and oil lubricated



3 Cutaway of an angle gear driving head for a vertical-shaft turbine deepwell pump. The power unit connects to the horizontal shaft in two ball bearings

4 Single-suction enclosed impeller in which waterways are shrouded

5 Single-suction semiopen impeller which has a shroud on top only

they are widely used in wet-pit and closed-suction systems. Drivers are mounted on the vertical axis of the pump, Fig. 1 and 2, minimizing space requirements. These pumps usually are installed with the impellers submerged, so that no priming is required, and suction problems are simplified, or practically eliminated.

Q 4—How are these pumps driven?

A—By electric motors, steam turbines or engines. Direct-drive vertical motors, Fig. 1 and 2, may have either hollow or solid shafts. Vertical-shaft turbines in a limited horsepower range are also used. Power from horizontal-shaft prime movers is transmitted through flat belt, multi-V belts, or right-angle gear drives directly coupled to the pump's vertical shaft.

Q 5—What is the performance range of these pumps?

A—Capacities vary from about 25 to 15,000 gpm or larger, for discharge heads up to about 1000 ft.

Q 6—What are the structural elements of these pumps?

A—A vertical-turbine pump contains three major assemblies, bowl *B*, column *C*, and driving head *H*.

Q 7—What standard construction variations are available?

A—Discharge opening may be above or below the foundation elevation. Lineshafts may be open to and lubricated by the liquid being pumped, Fig. 1, or enclosed in a tube and provided with lubrication from an outside source, Fig. 2.

Q 8—How are pump sizes listed?

A—Since these pumps were originally designed for installation in wells, their size is usually stated in that of the well casing in which the pump can be installed. For example, a 6-in. pump has an outside diameter of about 5½ in. and will go into a 6-in. well casing. An 8-in. pump is about 7½-in. OD and is intended to be installed in an 8-in. well casing.

Q 9—What is the bowl assembly?

A—It is the pumping element *B* of a vertical-turbine pump. Fig. 1 and 2. It contains the suction case, impellers, intermediate bowls and a discharge connection arranged for coupling the bowl assembly to the discharge column *C*. This assembly is sometimes called the working barrel or impeller section. Staging is done by increasing pumpshaft length and adding the required number of duplicate intermediate bowls and impellers.

Q 10—What is the suction case?

A—This is the pump's inlet *S*, Fig. 1 and 2. It guides the liquid at correct velocities to the eye of the first-stage impeller. The suction case contains straight vanes, which prevent prerotation of the liquid and support the bearing housing *A* of the bottom pumpshaft bearing. This bearing may be grease packed or lubricated by the liquid being pumped.

Q 11—What are the intermediate bowls?

A—These are castings, Fig. 1 and 2, with diffusion vanes *V*, which guide liquid flow from one impeller's discharge to the suction of the next. Each bowl has bearings to support the pumpshaft. These bearings are lubricated by the liquid pumped.

Q 12—What types of column assemblies are used?

A—They may have either threaded or flanged joints. This pipe connects the bowls to the driving head and serves as the discharge pipe. It is usually furnished in lengths of about 10 ft. Line-

FACTS YOU SHOULD KNOW

About the 1948 STEEL VALVE Outlook

AN ANNUAL REPORT
TO STEEL VALVE USERS

A year before the war started, steel valves became difficult to obtain. One of the most critical wartime industrial commodities, steel valves have been required in large quantities for postwar construction programs.

What is the situation now? How about prices, deliveries, new design developments? These are our observations . . .

LITTLE INCREASE IN VALVE PRICES

The steel valve industry has done its share in keeping prices down. Edward selling prices, for example, are now on the average only about 10 per cent above those in effect before Pearl Harbor. It is hard to think of any durable goods industry which today serves the buyer on such a favorable price-value basis. Steel valves are real bargains—they don't hold up construction programs because of high cost.

DELIVERIES IMPROVING, BUT—

Deliveries of Edward valves, on the whole, are considerably better than they were a year ago.

Most small forged steel valves are obtainable from stock or upon short delivery.

Larger steel valves, however, continue to require fairly long lead times and undoubtedly that will be the case for all of 1948. Expansion commitments of the steam generating, petroleum and process industries are such that there is little possibility that deliveries can be shortened very much on steel valves in sizes above six inches, particularly in the higher pressure and temperature series, until well into 1949.

It is therefore still wise to place steel valve orders as far in advance as possible.

ONE WAY TO CUT INVENTORIES

Most businesses are greatly concerned about mounting inventories. Among the several causes for increased inventories, we think, is the buying of "specials." Take the case of valves: standard valves with a high degree of interchangeability require the stocking of very few repair parts; non-standard valves with trick attachments mean extra inventories for repairs and delays in receiving emergency replacements.

The steel valve industry today has a complete line of standard valves suitable for fully 99 out of 100 installations. For better deliveries, lower cost, known performance and smaller inventories, stick to the standard.

NEW DESIGNS FOR NEW SERVICES

There is, as we said, a standard valve for virtually every service today. That is another way of saying that the valve industry has kept up with the technological advancements of the power, petroleum, and the varied process industries.

For instance, take Edward. Each new Edward catalog has listed basically new valves for higher pressures and temperatures. During the past year, Edward continued to improve its original designs for pressure sealed valve bonnets, welded body-bonnet valve joints, closing mechanisms, seating systems, etc.

Not all the advancement is confined to specific valve designs, either. For instance, the continuing research of the Edward laboratories into the characteristics of flow and the economics of pressure loss has not only led to the development of the Edward Equalizer for increasing flow through valves, but also has been widely heralded as a contribution to the knowledge of the fundamentals of flow through pipes. Edward engineers have shared their findings and experience with others interested in the same problem.

MEN AT WORK

As a unit of the Rockwell Manufacturing Company, Edward has access to the combined facilities of the other Rockwell plants in all parts of the United States.

This permits more economical manufacturing, an even greater research program, fewer headaches in obtaining materials and equipment which continue in short supply—in other words, more men and minds at work on a common objective.

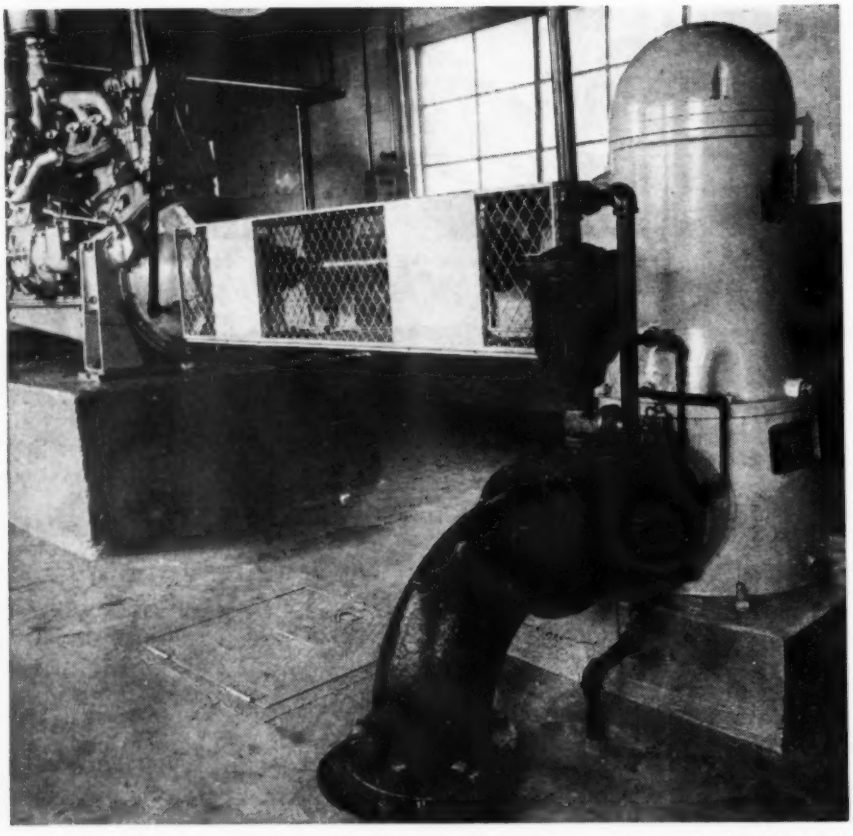
And right here at the Edward plant, employment is at an all-time high. Almost all the experienced Edward personnel that left for war service came back, and many new men and women have been trained. In 1947 expenditures for Edward production facilities also reached an all-time high, exceeding even our big wartime expansion programs.

Consequently we sincerely feel that we are in the best position ever to take care of your steel valve requirements in pressures from 150 psi up, in sizes from ⅛ in. to 16 in., for all temperatures, and for boiler room, petroleum, industrial, marine or technological service.

W. F. Crawford
President

Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO.
EAST CHICAGO, INDIANA



6 Vertical-shaft 1000-gpm turbine deepwell pump operating under 293-ft total head, and driven at 1750 rpm through an angle gear by 100-hp diesel engine

STANDARD MATERIALS IN VERTICAL TURBINE PUMPS

Bowl Assembly

Parts	*Material*
Bowls	Cast iron
Impellers	Bronze or cast iron
Wearing rings	Bronze
Bowl bearings	Bronze or rubber
Pumpshaft	Stainless steel

Column Assembly

Column pipe	Steel
Lineshaft and couplings	Steel
Shaft-enclosing tube	Steel
Enclosing-tube stabilizer	Rubber or bronze
Open-line shaft-bearing retainer	Bronze
Enclosed lineshaft bearings	Bronze
Open lineshaft bearings	Rubber
Open lineshaft sleeve	Monel or stainless steel

Head Assembly

Discharge head	Cast iron
Stuffing box	Cast iron
Stuffing-box gland	Bronze or cast iron
Top shaft: enclosed-shaft construction	Steel
Top shaft: open-shaft construction	Stainless steel or steel with stuffing-box sleeve

shafts usually come in 10-ft length connected by couplings, threaded so they cannot uncouple while pumping.

With open-shaft construction, Fig. 1, bearing retainers *R* support the bearings usually located at the end of each column-pipe section. Thus, if pipe lengths are 10 ft long, shaft-bearing spacing becomes 10 ft. With enclosed-shaft construction, Fig. 2, the shaft is enclosed in a tube, usually half the shaft's length and connected by bronze bearings threaded to serve as tube couplings. For example, if shafts are 10 ft long, bearings are spaced 5 ft apart.

Q 13—What determines shaft and column size?

A—Power requirements and thrust loads determine shaft sizes. Maximum allowable combined shear stress is 6000 psi, and maximum allowable combined tensile stress is 9000 psi as usually applied. Friction-head loss determines column-pipe size. Increasing column pipe size reduces friction-head loss. While this saves power, first cost is increased.

Q 14—What is the pump's driving-head assembly?

A—This is the portion of a vertical-turbine pump located above foundation level. When discharge is above ground, a discharge head containing a discharge elbow is included. This unit supports the pump driver and provides a base from which column and bowl assemblies are suspended.

When discharge is underground a simple motor support, similar to a spool piece, substitutes for the discharge head just described, and a discharge tee is placed in the column pipeline at the required location.

Q 15—Does type of shaft construction affect design of head assembly?

A—Yes, open-shaft construction requires a stuffing box and packing around the revolving shaft, whereas with an enclosed shaft, a stuffing box is not needed.

The shaft-enclosing tube keeps water from the shaft and since there is no rotation, a simple gasketed joint is used where the tube passes through the head assembly. Bottom end of the shaft-enclosing tube is vented to the well at *T*, Fig. 2, immediately below where it connects to the pump's discharge case or bowl. This vent prevents high-pressure water entering the shaft tube; consequently no pressure exists where the rotating shaft passes through the head assembly.

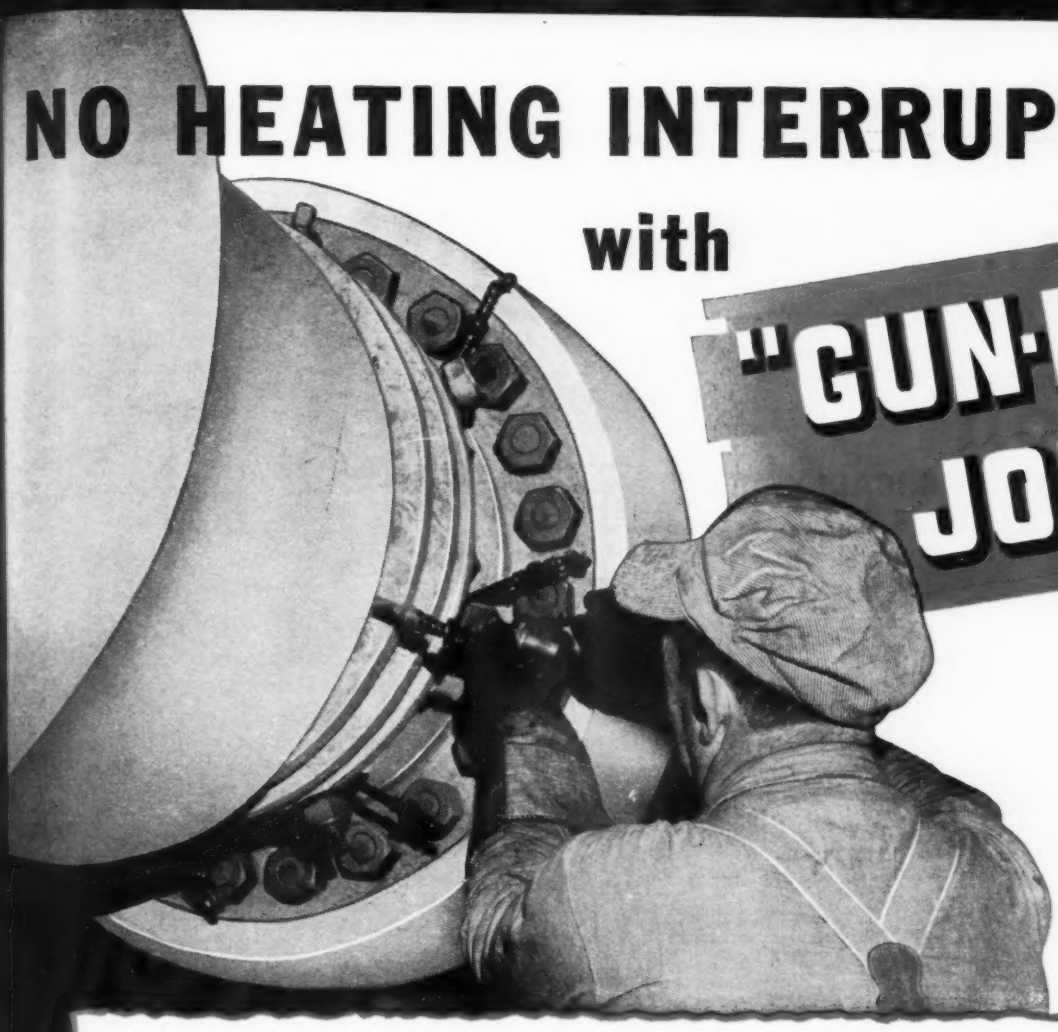
Various methods are used to admit lubricant to the enclosing tube, some of these use single- or double-ring packing to prevent lubricant overflow where it enters the tube. Such a stuffing box, however, does not come in contact with the pumped liquid.

Q 16—Does shaft construction affect bowl-assembly design?

A—Yes, with open-shaft construction the discharge connection is threaded or flanged for connecting to the bowl and column assemblies. When an enclosed shaft is used, the top bowl or discharge

(*Continued on page* 146)

NO HEATING INTERRUPTIONS with "GUN-PAKT" JOINTS



REVOLUTIONARY IDEA PERMITS SERVICING *UNDER FULL STEAM PRESSURE*

Shutdowns and service interruptions to add packing to expansion joints are things of the past.

Why? Because "Gun-Pakt" Joints *can be serviced under full steam pressure.* Insert a packing plug . . . twist a wrench . . . the joint's tight, the job's done. New Yarway packing rejuvenates the old.

The record proves . . . "Gun-Pakt" means minimum maintenance. Utilities, industrial plants, institutions, public works and other plants using steam distribution systems report savings of thousands of dollars annually in maintenance and operating costs with Yarway "Gun-Pakt" Joints.

To find out more, read Yarway Bulletin EJ-1911. It's free. Write today.

YARNALL-WARING COMPANY
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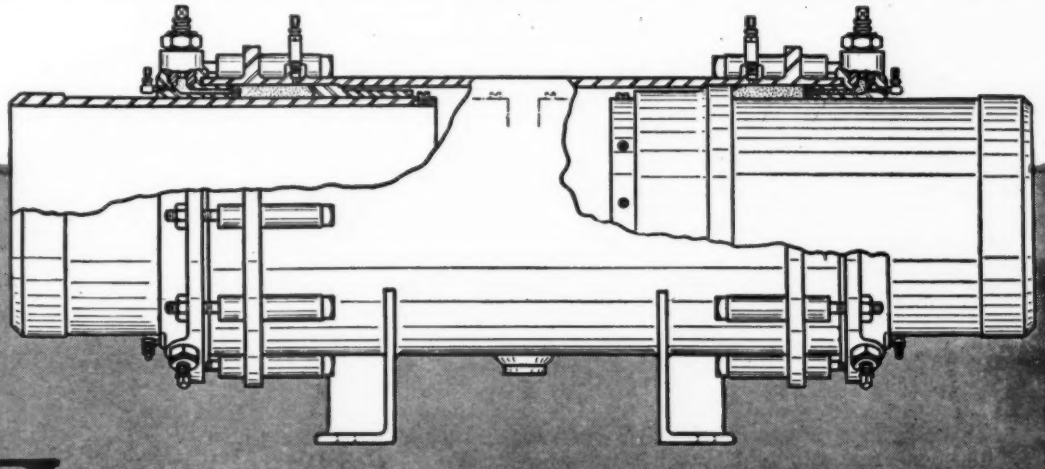


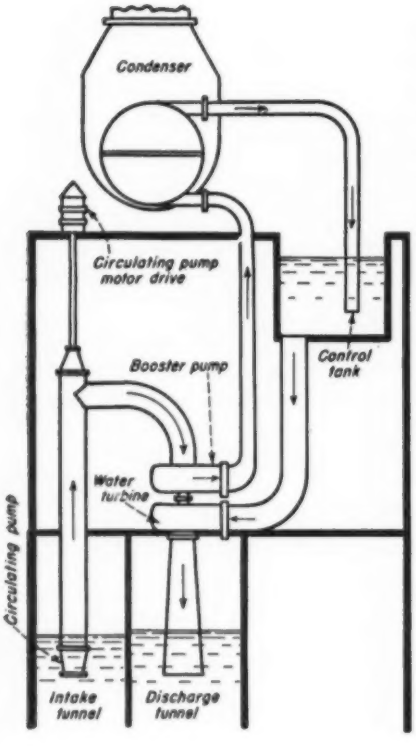
Sectioned drawing of double-end, welding-type Yarway "Gun-Pakt" Joint.

YARWAY **GUN-PAKT EXPANSION JOINT**

POWER ENGINEERS' NOTEBOOK

PLANT-TESTED IDEAS TO SOLVE PROBLEMS OF DESIGN, OPERATION AND MAINTENANCE

HYDRAULICALLY DRIVEN BOOSTER PUMP ALLOWS ELEVATED PLANT LOCATION



HIGH DEMAND for cooling water primarily dictates the placing of steam-electric plants within the area of a system. Because of the steady flow and relatively high-energy consumption for pumping required, special effort is usually directed toward maintaining a low pumping head through which the cooling water is lifted. This further limits locating the plant, along river banks, to sites of low elevation.

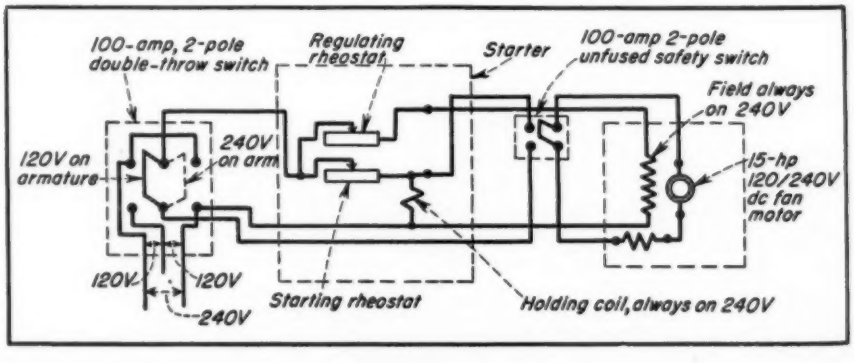
Studies of some sites have shown that placing plants at higher elevations than normal river level would lower substructure costs. This, together with the reduction in construction and operating hazards from flood waters, would justify the extra cooling-water pumping costs. Added to this advantage it proves economical to salvage part of the pumping energy by applying a booster pump driven by a water turbine that uses the energy in the cooling water discharged from the main condenser, as shown in the diagram.

This system was jointly developed by the engineering departments of Electric Advisers, Inc and Worthington Pump & Machinery Corp. One installation in the R E Burger plant of the Ohio Public Service Co pumps 55,000 gpm. The main electrically driven circulating pump, of 600-hp rating, can deliver 60% of maximum flow when working alone against about 60-ft static head plus friction losses. Full flow develops when the water turbine drives the booster pump.

Combined efficiencies of the hydraulic units are such that the turbine-pump unit salvages 70 to 80% of the power needed to develop the extra head. Water flow reaches design flow for lowest river stage and increases to 5% more at higher river stages. Power input to the motor-driven pump remains practically constant under the river conditions experienced. Pump and turbine characteristics are selected so that the control-tank water level remains stable. Pump-system factors are self-compensating and control proves no problem. At normal river stages the water turbo-booster recovers about 425 hp net.

USING AVAILABLE VOLTAGES INCREASES SPEED RANGE

IN THE STANDARD HOOKUP of a 240-v dc motor driving a fan, the available speed range was 1700 to 850 rpm, or 2:1. The fan supplies cooling air to a dry-type radiator and this speed range proved ample in warm weather. For winter conditions as well as light-load periods less air is needed than that provided by the lowest speed. To reduce the resulting excess auxiliary demand, motor connections were rearranged as shown in the diagram with the aid of a 2-pole double-throw switch. Thus either 240 or 120 v could be thrown across the motor armature circuit with the field always fed at 240 v.

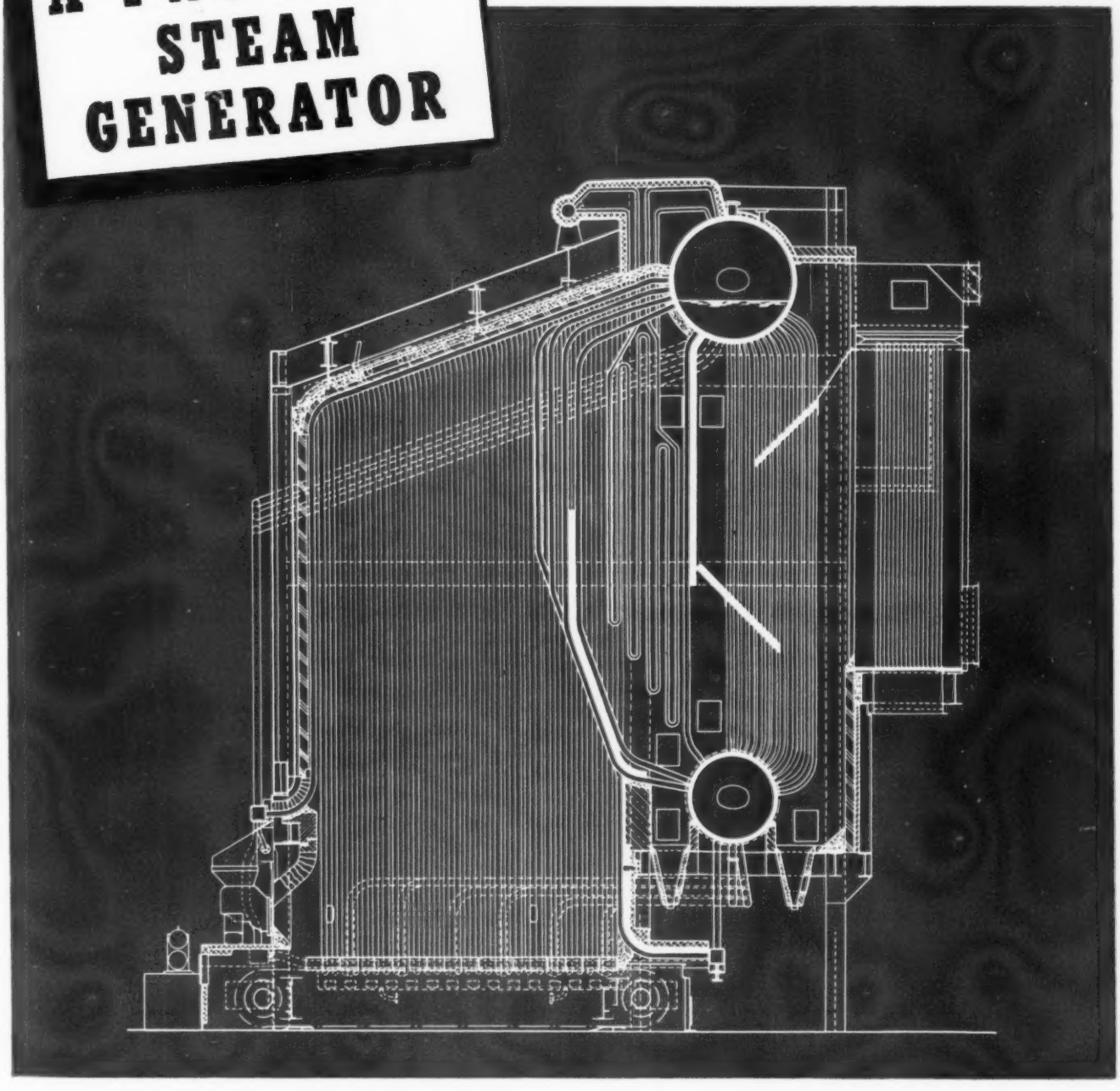


This gives the motor an additional speed range from 850 to 520 rpm or a total range of approximately 3.25 to 1.

(*Continued on page* 112)

A TWO DRUM STEAM GENERATOR

Location: NATIONAL LOCK CO., Rockford, Illinois.
Contractor: THE AUSTIN CO., Chicago, Illinois.

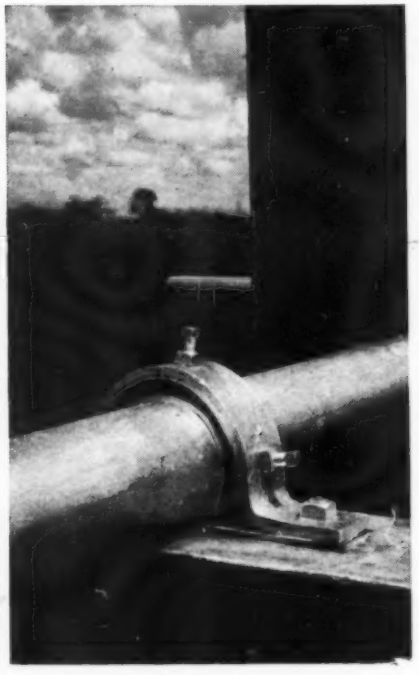


THIS two drum steam generator is a modern Springfield unit developed for The Austin Co., Chicago, general contractors for a power plant modernization project at the National Lock Co., Rockford, Ill. It is designed to produce 110,000 lbs. of steam per hour at 550 p.s.i. and 750°F. It is equipped to operate on Illinois coals with continuous ash discharge spreader stoker.

Springfield service includes design, fabrication, and erection of units complete with firing, draft, and control equipment—all taken under a "Single Responsibility" contract. We will be glad to submit a proposal covering your requirements. Write to our main office in Springfield, or see your nearest Springfield representative. SPRINGFIELD BOILER CO., 1953 E. Capitol Ave., Springfield, Illinois.

SPRINGFIELD

ANY SIZE • ANY FUEL • ANY PRESSURE



Line Chafing Sleeve Prevents Scoring

EXPANSION AND VIBRATION, from surges set up by compressors, cause high-pressure gas lines to shift. Lines must be anchored against lateral shift, but be free to adjust themselves longitudinally without stress concentration. One such installation uses customary concrete piers for line support and anchor, bolting the usual saddle over the pipe at intervals. Three heavy-set screws, fitted with locknuts, help adjust pipe position. These are shown in photo, left, of an actual installation.

Instead of the screws bearing directly on the pipe where they may cause scoring or nicking, they engage a chafing strip, made of ⅜-in. steel and formed to hug the pipe closely. A second chafing strip on the pier-bearing plate takes the wear underneath.

M H PEARCE *Carthage, Texas*

CONTRIBUTIONS INVITED

With many familiar departments passing on to the new *Operating Engineer*, new services to engineers in the field are pioneered by POWER, of which this Power Engineers' Notebook is one. Here we will collect ideas that work, solutions to problems big and little that plague power men dealing with design, operation and maintenance. They will range over the entire field—mechanical, electrical, hydraulic, structural, drafting-room practice, quick computing methods, operating procedures, maintenance elimination.

Many POWER readers have ideas and techniques they have used successfully that ought to be passed along for everyone's benefit. POWER pays $20 for each accepted item.

PLAN FOR EXTENSIONS IN POWER-PLANT DESIGNS

ADDITIONS AND EXTENSIONS to power plants, even when the design is considered ample to cover ultimate demands, are now so frequent that a capable engineer takes especial care to see that no detail is overlooked that might aid future growth. One power plant, with 8800 hp of gas engines, made provision in the original layout of fuel lines, cooling-tower mains, and cooling lines for engine-temperature control, so that it will scarcely be necessary to shut down the circulating pumps to tie-in to the future units.

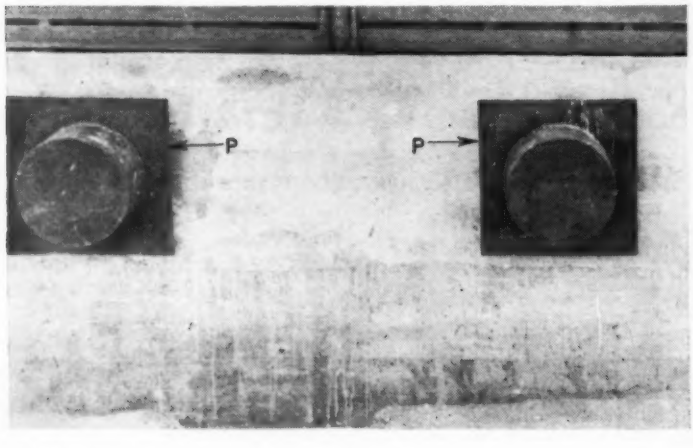
The water mains through the concrete base of the cooling tower, *left photo*, are not dead-ended within the foundation, as is usual practice. Instead, they are carried out 12-in. beyond the existing wall. A square plate *P*, welded to the protruding pipe, forms the closure against the pit's outer side wall when it is built to accommodate cooling-tower additions. Beyond the wall-facing plate the pipe extends far enough to pass through the new pit's wall and allows for welding the main for the new unit. To tie to the existing mains it will be necessary only to cut off flow long enough to burn out the sealing disk, and weld the two lines together.

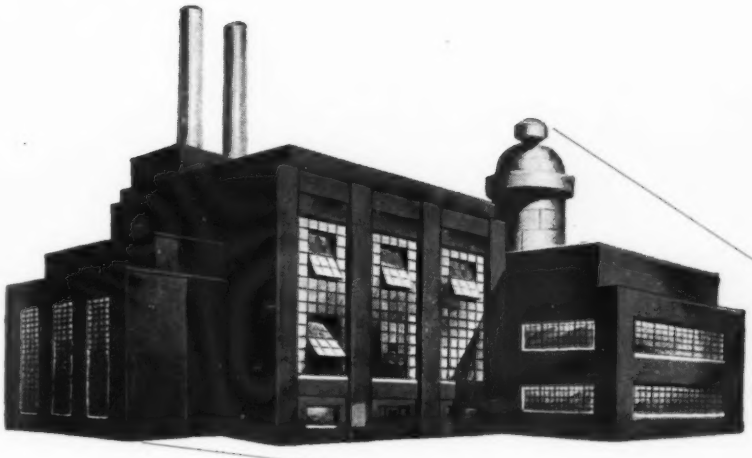
The two cooling-water lines for the engines are supported on brackets along the station wall, *right photo*, with the inner and smaller line carrying the cold water, under pump pressure. The larger line carries the water from the engines and delivers it to the circulating system at the towers.

Where the present engine installation stops, the two lines have standard welded flanges with a ¼-in. blank disk between them. A short pipe nipple is welded to the outside half of the flange joints so that connection can be welded to them without disturbing operation of the present system.

When new equipment is added it is necessary to cut off water flow only long enough to remove the blind disk from each joint. Then replace the disk with a spacer ring, already bored to pipe diameter and with the proper bolt holes, and tighten the flange bolts. After this the system is again ready for operation.

Houston, Texas ELTON STERRETT





Then there's the rule of *Thumb* method

. . . when scientific knowledge is replaced by instinct.

It's a good rule to follow for some things, but totally inadequate for *efficient* boiler plant operation.

Correct water conditioning, for instance, is a matter of careful and scientific control.

W. H. & L. D. BETZ is an organization of engineers and chemists specializing in the solution of all industrial water problems. Years of experience have made Betz water conditioning service scientifically correct . . . complete . . . economical. Our staff of engineers will welcome the opportunity of discussing your boiler water problems . . .
W. H. & L. D. BETZ, Gillingham and Worth Sts., Philadelphia 24, Pa.
In Canada: Betz Laboratories Limited, Montreal 1.

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BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

PROBLEMS FROM THE PLANT

Exercise your engineering wits by submitting answers to this question, fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

How Is Slipring-Motor Resistance Calculated?

WE HAVE a 150-hp 440-v 3-phase slipring conveyor motor that has caused us to change hookup twice. It is apparent that the wrong secondary grid resistors have been shipped with this installation. We have about doubled the size of the bank, but still don't get proper speed regulation. We operate it from a 12-step drum-type controller on the secondary. It is started and stopped with start-stop pushbuttons through a magnetic contactor in the stator circuit. The primary current is 176 amp and the secondary current 190. The speed is 1150 rpm.

On the first test, under no load the rotor started at about 1000 rpm. The grids were then rearranged and some added, to give about double resistance. On the second test under full load the starting speed was still high as it was over 800 rpm.

I would appreciate it if some POWER readers would give me a formula or other definite information that I can use to determine the correct cross section and resistance of the grids for the 12-step controller. I want a resistance that gives maximum safe starting torque and equal acceleration up to full short circuit of the rotor.—*JHV*

Readers' Answers

How Can I Stop Belt Slippage on Flywheel?

(This question is from Oct issue with best answers from readers.)

We have trouble with slippage of a belt that drives an ac generator from a steam engine. The unit, an 18x42-in. 400-hp corliss with a 15-ft. flywheel, has a 28-in. face. The engine runs about 102 rpm and drives a 275-kw 60-cps ac generator through a 34-in. pulley. Generator speed is 514 rpm. Belt is 28 in. wide, of 3-ply leather. Center-to-center distance from generator pulley to engine flywheel is 20 ft, 8 in. A heavily weighted idler at the generator gives a good belt wrap on its paper pulley. Usually the generator runs synchronized with an outside power source.

Trouble is that when we carry a heavy load of about 250 kw on the generator the belt slips on the engine flywheel, as the polished condition of the metal flywheel face shows. Slippage heats the belt noticeably and is shortening its life considerably.

I have heard that a rider belt, about half the width of the main belt and riding on top of it, greatly helps this condition. Do POWER *readers agree or have they a better solution?—IM*

Change Tension And Adjust Idler

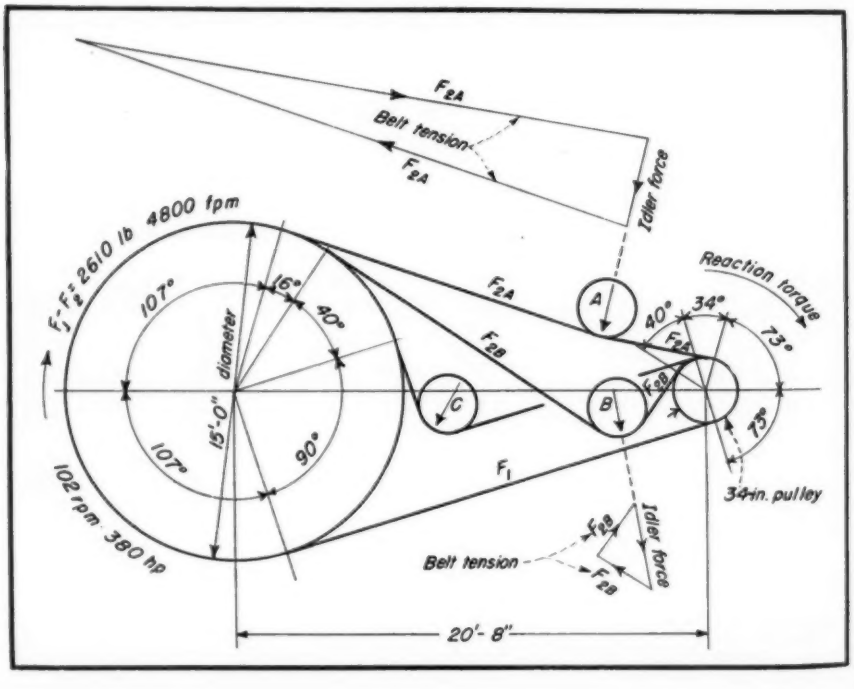
ASSUMING AVERAGE ALTERNATOR and belt efficiencies I find that about 380 hp is transmitted for 250 kw. A 24-in. triple-ply heavy-leather belt should transmit 400 hp continuously without undue wear. Excessive load does not cause excessive slip.

I will pass over expensive solutions, such as facing the flywheel or mounting the alternator on a pivoted base so reaction torque increases belt tension with load. We can still make improvements by relocating the idler or increasing belt tension, or by doing both.

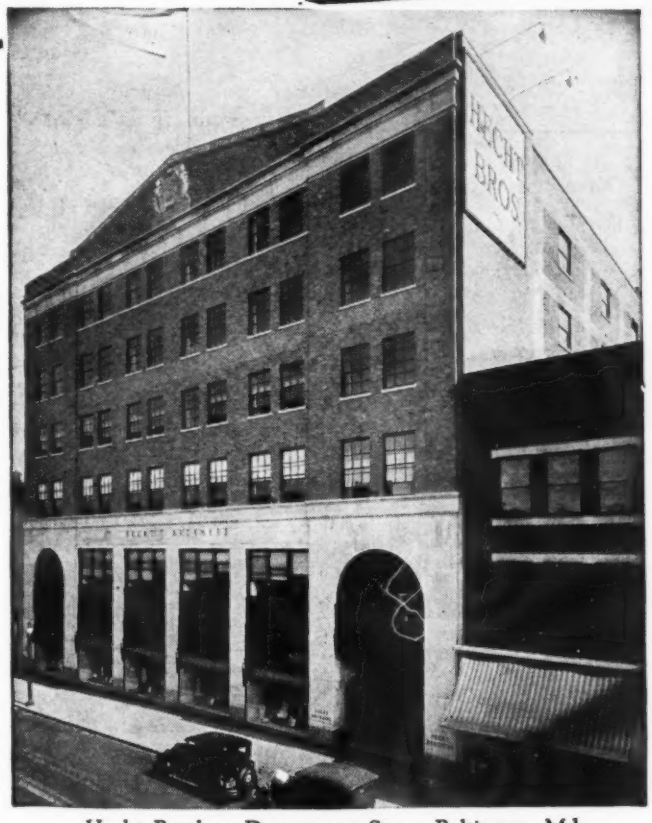
At present the idler is in position *B*, see sketch below. This gives good belt wrap on the small pulley. Actually, the coefficient of friction *f* times the angle of wrap need be only the same for each pulley. Since *f* for paper is 1½ times *f* for iron, the angle of wrap on the flywheel should be 1½ times that on the paper pulley. It is about this without any idler at all. The ratio is now 214 to 146 deg. Hence, if the idler is used to increase angle of wrap, it would be far better mounted at *C* where it gives 270 deg on the flywheel and 180 deg on the generator pulley.

The given speeds indicate 4.8% slip. A trial check shows that belt tension must be low. This can be increased by increasing the load on the idler, whether in position *B* or *C*, or by shortening the belt and forcing idler to position *A*. The vector diagrams on the sketch below indicate how much this increases belt tension without increasing idler bearing loads.

It is unusual to operate a belt wider than 26 in. on a 28-in. pulley face. Working along the edges of a 28-in.



20-Year Record of Heating Comfort



Hecht Brothers Department Store, Baltimore, Md.
Heated by Webster Steam Heating System since 1927.

This is the 20th year of Webster heating service at Hecht Brothers Department Store in Baltimore, where management has long recognized that heating comfort is an important factor in successful department store operation.

In 1927, when the present home of Hecht Brothers Department Store was built, a Webster Vacuum System of Steam Heating was specified by Abbott, Merkt & Co., Inc., New York, Architects and Engineers. The installation included Webster Radiator Traps and Supply Valves, Webster Float and Thermostatic Traps and Dirt Strainers and a Nash Vacuum Pump. Riggs, Distler & Co., Inc., Baltimore, were the heating contractors.

In 1941, Hecht Brothers decided to discontinue their coal-burning boiler plant and purchase street steam from the Consolidated Gas Electric Light & Power Co. On the recommendation of the Gas & Electric Company, they decided to convert the installation to a Webster Moderator System, then as now recognized for comfort at low cost.

Installation of a 3-Valve E-4 Webster Moderator System, controlling 15,824 square feet of installed direct radiation, was completed during the heating season without interruption in store operations. Webster Radiator Valves were fitted with expertly sized Webster Metering Orifices so that all radiators would heat evenly. The existing piping was retained.

Hecht Brothers Store faces north. The heating installation is zoned to compensate for the sun effect by delivering proportionately more steam to the north side of the building. Radiators in sections of the store warmed by solar heat receive less steam. Steam savings are appreciable.

Since the introduction of district steam service, there has been a noticeable improvement in cleanliness, an important factor in department store operation. The dust, dirt and smoke which go with many private plants are avoided.

Sam Hecht, President of Hecht Stores, and William P. Calhoun, Store Manager, look upon their Webster Heating System as an investment in customer satisfaction. Webster Service is provided by Baltimore Representative H. M. Harris, with Webster for 18 years.

If you are interested in heating comfort at low cost backed by the experience of long-service Webster Representatives, give us a few facts about your heating requirements.

WARREN WEBSTER & CO., Camden, N. J.
Representatives in principal U. S. Cities : : Est. 1888
In Canada, Darling Brothers, Limited, Montreal

Webster
HEATING SYSTEMS

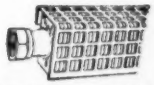
Webster Heating Equipment for Today's New Buildings

Webster Metering Orifices, expertly sized, a vital feature of the Moderator System, balance distribution and make possible central control with continuous heating.

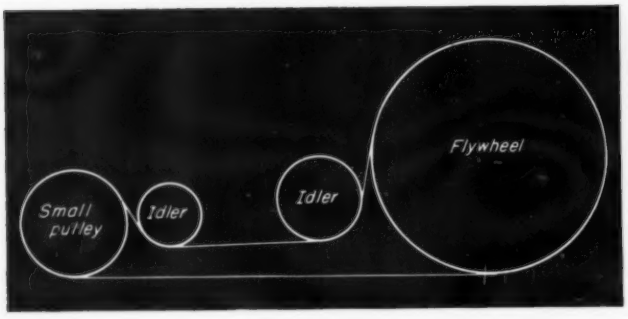
Webster Outdoor Thermostat Control automatically provides the lowest pressure for comfortable inside temperature.

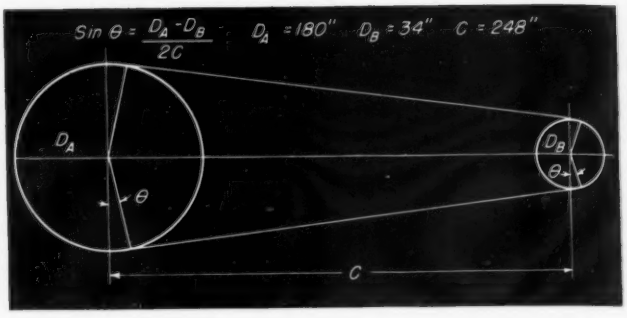
Webster Float and Thermostatic Drip Traps are used on heating coils of air conditioners and drip points of the piping system.

Prefabricated Unit—Webster System Radiation convectors with copper tubing, aluminum fins, *integral* Webster Traps and Valves.



New! Webster Type WI Radiation for installation where floor or wall space is limited.





belt can cause heat and destruction. Strangely enough, in *IM's* case slippage would be less on a 24-in. belt subject to same pull. Reason is that a belt weighing less per linear foot creates less centrifugal force. Hence a larger percentage of the belt is available for driving, as less is needed to overcome centrifugal force.

Brantford, Ont. W L GOVAN

Resurface Flywheel

YEARS AGO I saw a rider belt on a drive similar to that mentioned by *IM*. It was in a plant of the Johns-Manville Co in Brooklyn. The rider belt did stop the slip. But belt dressing was also applied, and I believe it was partly responsible for the result.

Another method is to apply a friction facing on the flywheel. This friction material can be nothing more than thin duck canvas, glued securely on the surface of the pulley.

Usually it is the smaller pulley that slips, not the large one. In this case the idler pulley very likely takes care of the smaller pulley, giving it sufficient arc of contact. This suggests the use of another idler pulley as shown above. This will increase the arc of contact on the flywheel. I have never seen two idlers on a single drive but see no reason why they would not be practicable. I believe the friction loss would be less than with a rider belt.

My suggestion is this: First use a high-grade belt dressing. If that doesn't solve the problem completely, give the flywheel a friction surface. I believe that would cost less than a second idler pulley. Cost, these days, is important.

Newark, N. J. J H SQUIRES

Belt Is Heavy Enough To Pull the Load

I CHECKED IM'S PROBLEM to see if his belt is good for the horsepower it must deliver. I used the following formula:

$$Hp = \frac{v \times T_2 \dfrac{(\log_e \mu\alpha) - 1}{\log_e \mu\alpha}}{33{,}000}$$

v = velocity of belt in ft per min
T_2 = Maximum tension of belt
μ = coefficient of friction, which is 0.3 for leather to cast iron
α = arc of contact in radians. For convenience, $\log_e$ can be changed to $2.3026 \times \log_{10}$.

The arc of contact is obtained from the formula shown on the sketch above, and is found to be 215 deg.

Since we do not know the diameter of the idler, which would add some to the arc of contact, we will omit it.

T_2 is obtained by

$$T_2 = T \times A - T_c$$

T = allowable unit tension of 1 sq in. of leather belt; it is 425 lb per sq in., and A is the area
T_c = centrifugal tension of belt, obtained by

$$T_c = \frac{W \times v^2}{g}$$

W = weight of a ft length of belt, obtained by multiplying 0.43 by the cross-sectional area of the belt. I assume 3-ply belt is ½ in. thick.
v^2 = belt velocity in ft per sec squared.
g = the force of gravity = 32.2.

I worked this out, and found the belt good for over 400 hp. Since it is equal to the job, let us see where the trouble is. The only thing we can alter is the friction between flywheel and belt.

The practical way is to clean the contact side of the belt thoroughly. Remove all oil and gum with a good cleaner or fuller's earth. After this thorough cleaning, coat the surface freely with neat's-foot oil. The process should be repeated regularly. I believe this will stop all slipping.

I cannot see how a rider belt will help.

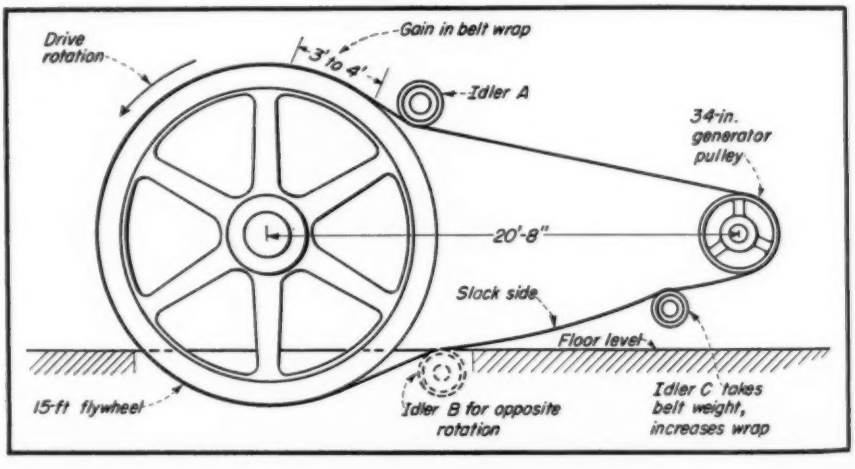
Bronx, N. Y. GEORGE GRIFFEL

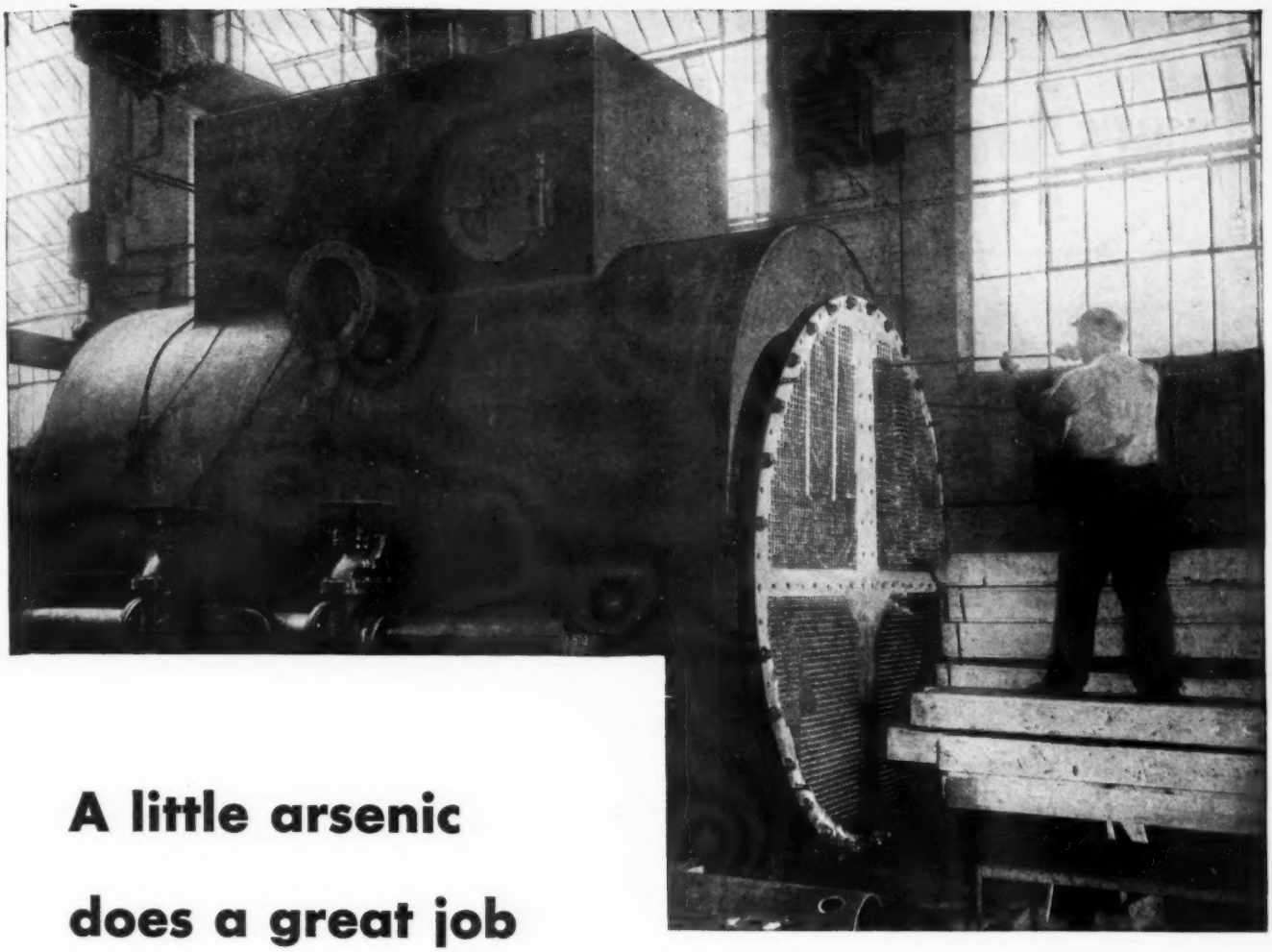
Put Idler at Flywheel

IM COULD PROBABLY ELIMINATE some slip on flywheel by using a rider belt. Usually the slip between belts offsets any gain because of excessive wear on both belts.

His idler pulley should be placed at *A* or *B*, as in sketch below, depending on rotation of flywheel to increase belt wrap or contact on flywheel. To get best results don't have belt too tight before applying the idler. Neither should belt be too slack, as this will put an excessive load on the idler. This is especiallly important on heavy multiple leather belts like *IM's* as they are hard to flex. I recommend using a small amount of good-quality-stick belt dressing to increase belt grip on flywheel. If outside of belt is rubbed with a little neat's-foot oil every few months it keeps belt pli-

(*Continued on page* 152)





A little arsenic does a great job ...increasing resistance to dezincification

FIFTEEN YEARS AGO engineers of The American Brass Company found that the addition of a very small percentage of arsenic to the standard Admiralty Alloy would substantially increase its resistance to corrosion by dezincification.

Arsenical Admiralty "439" alloy has been produced since 1934, and has given consistently satisfactory performance in almost every kind of service. This alloy is but one of 10 standard and several special Anaconda Condenser Tube Alloys. They cover a wide range of heat transfer requirements. For further information, ask for Publication B-2—or consult our Technical Department on choosing the alloy best fitted to your needs.

Illustration shows Anaconda Arsenical Admiralty Tubes going into a new condenser being built for a Missouri utility by the C. H. Wheeler Manufacturing Co. in Philadelphia. This dual-bank, two-pass type condenser, has a surface area of 11,000 sq. ft. and a capacity of 77,000 pounds of steam per hour. Tubes are ¾" O.D. x .049" wall and 16' 2⅜" long. Tubes sheets are Anaconda Muntz Metal — 1⅛" thick x 104" diameter.

47138

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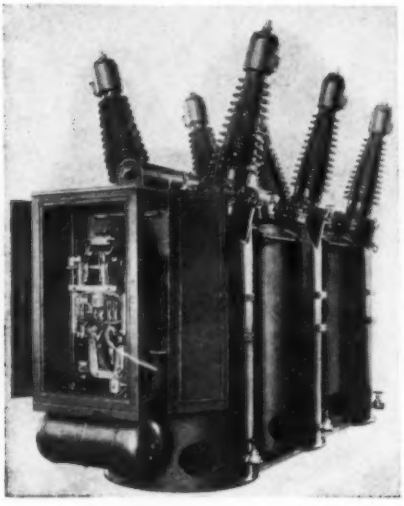
WHAT'S New IN PLANT EQUIPMENT



Circuit Breaker E1

REDESIGNED FOR RATINGS from 115 to 230 kv, and up to 3,500,000 kva interrupting capacity, this improved line meets requirements for reliable, high-voltage transmission-line circuit-breaker protection. Type *BZO*-160 is an improved line of high-voltage, high-speed, quick-clearing (5-cycle) outdoor, floor-mounted oil-circuit breaker. This unit recloses service within 20 cycles and includes the proved single-brake 5-cycle *Ruptor* arc extinguishing device and pneumatic operator with self-contained automatic air-supply system.

It has weatherproof mechanism box on top of each tank which is readily accessible for adjustment. Either bushing or bushing current transformer is removable without disturbing the other. Complete oil-maintenance facilities are afforded on each pole. **Allis-Chalmers Mfg Co, Milwaukee, Wis.**

Gate Valve E2

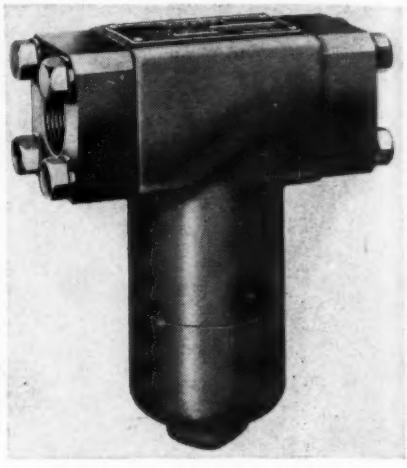
UNION BONNET, FIG. 2228, GATE VALVE is made of bronze and has a double-disk union bonnet. It has rising stem and screwed ends and is rated at 200-psi SP. Companion valve, Fig. 2229, has flanged ends, is rated at 150-psi SP. Available in sizes from ¼ to 3 in. Additional features are the patented silicon-alloy stem material that eliminates stem-thread failures, hexagon head gland, beveled-disk wing guides and body guide channels to make assembly easy when servicing the valve. **Lunkenheimer Co, Cincinnati 14, Ohio.**

Gear Rotary Pumps E3

FOR CONTINUOUS SERVICE at 1000 psi and intermittent service at 1500 psi, gear rotary pumps are rated 5½ gpm at 2800 rpm, 8 gpm at 1800 rpm, and 15 gpm at 1200 rpm. They are for pressure lubrication and oil hydraulic service. Wear-resisting material is used, such as *Nitralloy* gears operating inside chrome-plated faces of cast-iron housings. Pumps have pilot-type flush mounting face, suitable for direct attachment to machinery or other equipment. Pumps can be driven direct or by belt, gear or chain. **Aro Equipment Corp, Bryan, Ohio.**

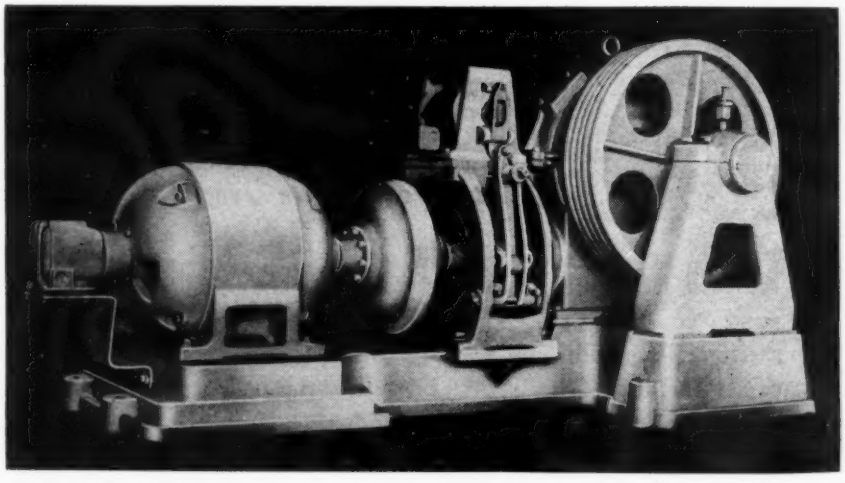
Boiler Control E4

INSTRUMENT CONTROLS COMBUSTION in hog-fuel-fired boilers by brilliancy of the flame, furnace wall, or fuel bed. Forced draft is controlled by steam pressure, induced draft by furnace draft, and fuel feed by steam flow, but is readjusted by brilliancy instead of steam flow-air flow ratio. Brilliancy is measured by a photo-voltaic cell connected to a Bailey *Pyrotron* pyrometer. If flame brightens it is a sign of excess air, and fuel feed is increased gradually until flame darkens to required brilliancy. Conversely, if flame tends to darken, fuel feed is correspondingly decreased. **Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland 10, Ohio.**



Proportional Oil Filter E5

PROPORTIONAL OIL FILTER uses a cartridge that removes particles down to two microns' size. Reversible filtering action meets requirements of closed circuits. By-pass valve is not necessary because venturi action in filter controls maximum pressure built up across cartridge. Filter may be installed in any horizontal hydraulic-system pressure line. Filter protects system against dirt, sludge and chips. It has no moving parts, so maintenance is reduced to periodic replacement of inexpensive cartridge. **Vickers Inc, 1596 Oakman Blvd, Detroit 32, Mich.**



Fluid-Drive Elevator E6

FREIGHT- AND PASSENGER-ELEVATOR machines are equipped with fluid drive to reduce installation, maintenance and operating costs. Fluid drive, installed between motor and brake wheel, is similar to many industrial drives that make difficult starting easy. Because of the drive a smaller motor can be used, as it does not have to start under load. When car switch is closed motor starts and accelerates to nearly full speed before fluid drive takes hold. Starting current and power costs are

Use convenient reply cards on page 180A to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.

Your Everyday Piping Needs Now Filled from Local Stocks

No waiting for most regular items at your Crane Branch or Wholesaler

Stock bins are rapidly filling up at local Crane outlets. Day by day, in valves, fittings, steam specialties, piping accessories . . . brass, iron, and steel . . . the selection keeps rounding out.

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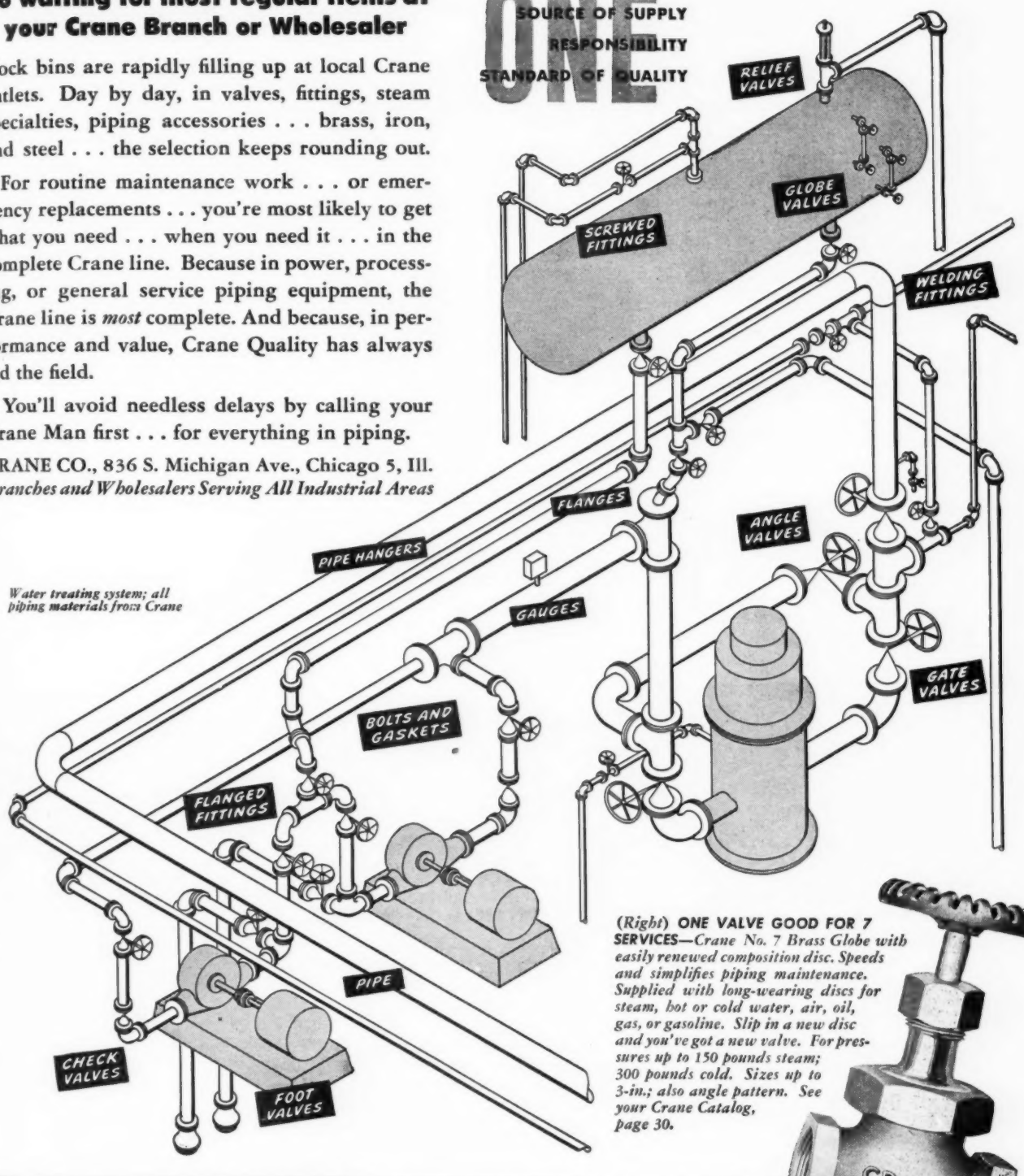

Water treating system; all piping materials from Crane

(*Right*) **ONE VALVE GOOD FOR 7 SERVICES**—*Crane No. 7 Brass Globe with easily renewed composition disc. Speeds and simplifies piping maintenance. Supplied with long-wearing discs for steam, hot or cold water, air, oil, gas, or gasoline. Slip in a new disc and you've got a new valve. For pressures up to 150 pounds steam; 300 pounds cold. Sizes up to 3-in.; also angle pattern. See your Crane Catalog, page 30.*

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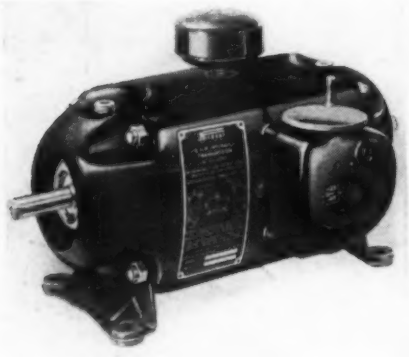
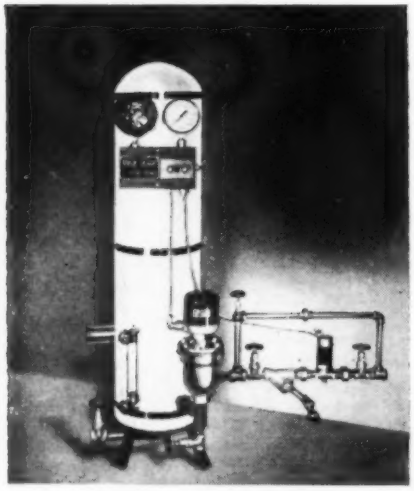
FOR EVERY PIPING SYSTEM

therefore reduced. Motor-control equipment is reduced to two-direction switches, one for each direction of travel. Electronic control levels car at floors. **Warsaw Elevator Co, Warsaw, N. Y.**



Hydraulic Transmission E7

VARIABLE-SPEED hydraulic transmission, for fractional-horsepower machinery drives, has smooth and stepless speed adjustment from zero to maximum output speed in either direction of rotation. Full torque is maintained for full-speed range. Automatic overload protection prevents unit being damaged if stalled. This transmission is rated ½-hp continuous duty. Speed adjustment over complete range is by either handwheel or servocontrol. **Vickers Inc, 1596 Oakman Blvd, Detroit 32, Mich.**

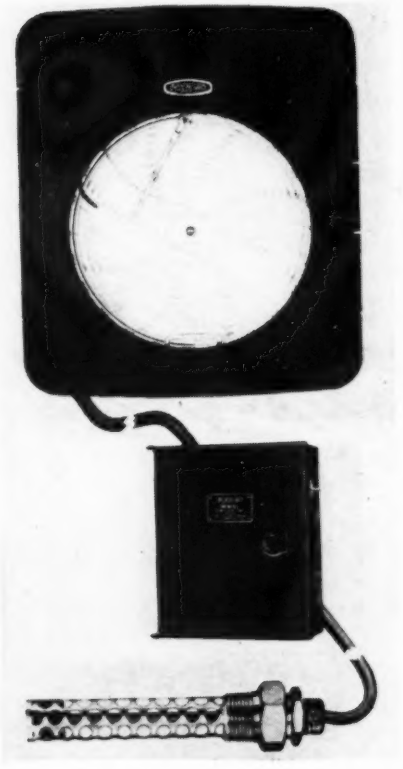


Condensate Drainer E8

QUIK-TEMP ACCUMULATOR, built for working pressures up to 150 psi, handles drainage from steam-heated machines. Large diameter nonclogging metering units are installed in the return lines in place of conventional steam traps. Based on results obtained from initial installations, the manufacturer offers the system to all users of steam-heated process equipment to which it may be applied with a guarantee of 10% minimum increase in production potential. **Fred H Schaub Engrg Co, 2110 South Marshall Blvd, Chicago 23, Ill.**

Axial Flow Fans E9

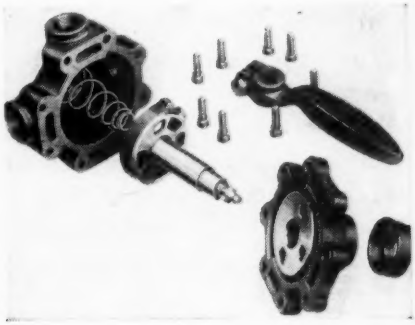
LINE OF AXIVANE ADJUSTABLE-BLADE FANS, *Series* 1000, is available for heating, ventilating and air-conditioning requirements. Fans are for a range of pressures up to 9.60 in. of water and volumes up to 100,000 cfm. They come in 124 models in 15 housing diameters from 18 to 60 in. and four speeds. **Joy Manufacturing Co, Oliver Bldg, Pittsburgh 22, Pa.**



Dewpoint Recorder E10

SENSITIVE ELEMENT in this recorder, called the *Dewcel*, consists of a thermal bulb wrapped with a saline-saturated woven-glass tape and two windings of silver wire, to conduct the heating current. Moisture determination is based on fact that for every water-vapor pressure in contact with a saturated salt solution there is an equilibrium temperature at which the solution neither absorbs nor gives up moisture to the atmosphere. The variable heat supply brings the *Dewcel* to this equilibrium temperature. The temperature, then measured by thermal bulb, is transmitted to recording instrument and indicates on a chart dewpoint temperature. Recording is continuous. Various chart ranges are available, −20 to +92 F, and 36 to 160 F temperatures.

Two types are available. One is the *Dynalog* all-electronic instrument, and the other is a liquid-filled type. The instruments require no refrigeration, water supply, or air-circulating system, and have no mirrors to clean. They can be installed indoors or outdoors. Recording instrument can be mounted 600 ft away from the *Dewcel*. Current consumption is from 1 to 8 watts. **Foxboro Co, Foxboro, Mass.**



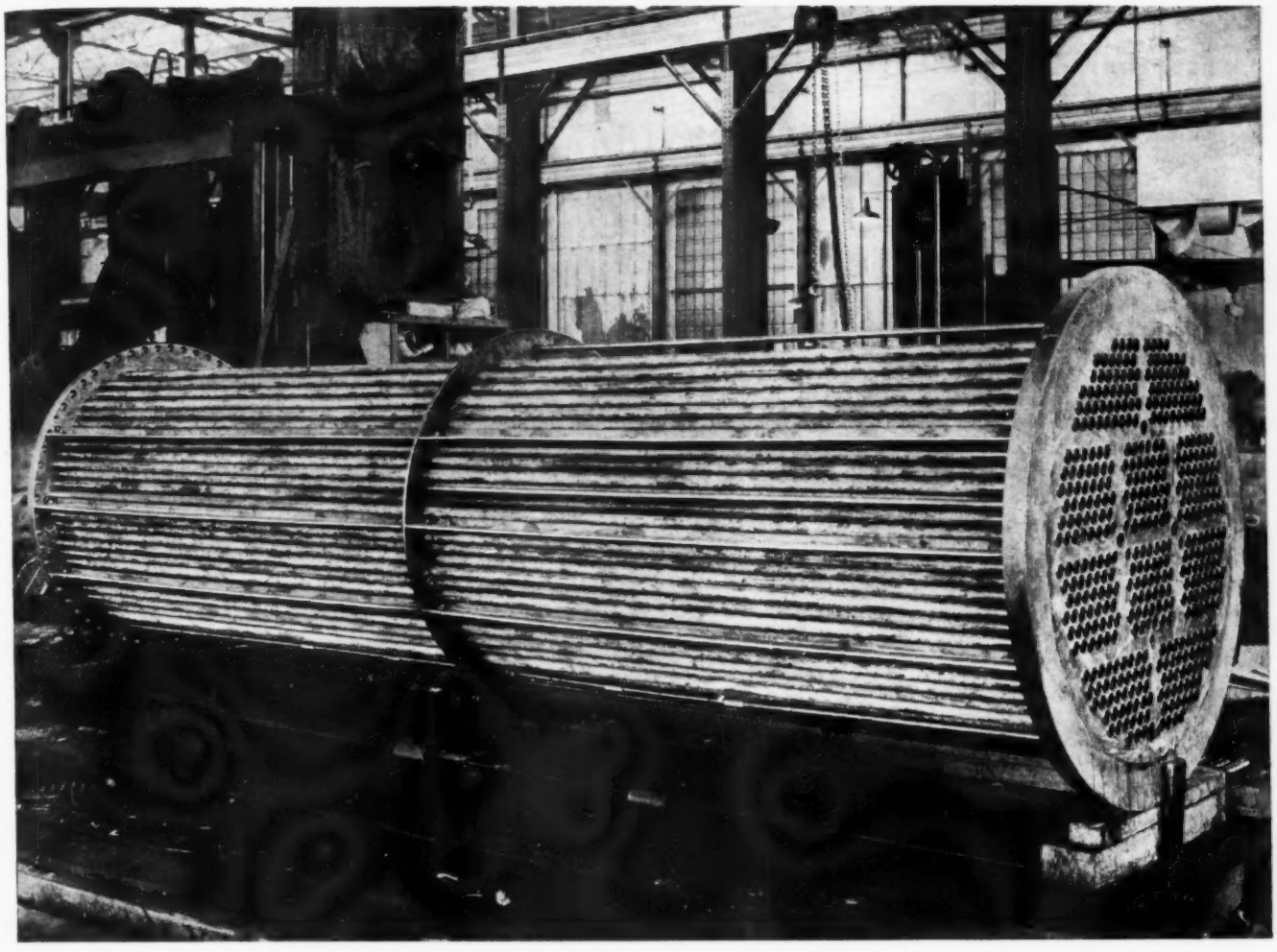
Lubricated Valves E11

UNITITE VALVES, for air and hydraulic lines, have recently been redesigned to incorporate a new protective dust seal. Seal consists of a *Neoprene* skirt mounted on the valve stem underneath the handle to shroud bonnet boss snugly, thus protecting working parts from dirt. Lubrication fitting is mounted in the stem so valve disk and stem are pressure lubricated radially outward from the center. **Hanna Engrg Works, 1765 Elston Ave, Chicago 22, Ill.**

Humidity Indicator E12

ALL-METAL HUMIDITY INDICATOR is of the wet- and dry-bulb type. Main features are the all-metal Weston laboratory thermometer, self-supporting wet-bulb wick covering the thermal element, all-metal construction, and a simplified slide-rule calculator that gives relative humidity readings directly. The calculator, located on face of

Use convenient reply cards on page 180A to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.



ELECTRICITY CAN BE CORROSIVE, TOO

OPERATORS of condensers are well-informed and follow sound general practices that should result in satisfactory tube life, but it has been estimated that in about 90% of American plants there is at least one piece of equipment that shows tube trouble. Such cases interest Revere greatly, because we want condenser tubes to give satisfactory, economical service.

Sometimes the causes of premature failure are obscure and difficult to discover. One of them is stray electricity. When you remember that copper plating is usually done at about 4 to 6 volts, you can see that it doesn't take much to move metal from one place to another through a fluid. Any flow of current through a condenser is sure to be destructive.

Electricity often finds strange routes to ground through high-resistance shorts that do not show up through blown fuses, overheated parts, arcing, and similar obvious indications. Pump motors, for example, may work perfectly well, but permit a little "corrosive" electricity to pass along to ground through the condenser; electrolysis results. Galvanic action, due to the use of metals of too-great dissimilarity, may also occur, but is rare in a condenser properly designed for its operating conditions.

So Revere suggests you include electricity as a possibility when seeking the causes of unexpected tube failure. And it is also advisable to save samples cut from failed tubes, to be sent to Revere for laboratory examination. Facts thus scientifically uncovered may lead to recommendations that will solve the problem. If you have a condenser tube problem, ask Revere to help.

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• • •

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Equipment *Continued*

instrument directly beneath 2-dial thermometers, indicates relative humidity from 10 to 100%. **Weston Electrical Instrument Corp, Newark, N. J.**

Thread Compound E13

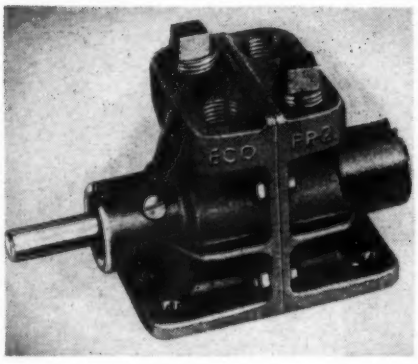
FEL-PRO HI-TEMP THREAD COMPOUND is said to prevent freezing and galling of metal surfaces at temperatures as high as 1800 F. The new *C*-5 compound can be used on furnace-tube headers, studs and plugs and other high-pressure high-temperature applications. **Dept P 218, Felt Products Mfg Co, 1504 Carroll Ave, Chicago 7, Ill.**

Tachometer E14

HAND-HELD ELECTRIC TACHOMETER weighs only 3 lb and gives accurate and direct readings of linear speeds from 10 to 10,000 fpm, and of rotational speeds from 100 to 10,000 rpm. Using accessories, rotational speeds from 10 to 100,000 rpm may be measured. Speed ranges can be changed while spindle is rotating because there is no gear transmission to shift. Instrument cannot be damaged by overspeeding. It can measure both clockwise and counterclockwise rotation. Tachometer comes in a carrying case. **General Electric Co, Schenectady 5, N. Y.**

Gridded Bearings E15

HEAVY-DUTY, HIGH-SPEED BEARINGS for diesel engines and heavy machinery consist of a centrifugally cast lead-bronze shell with its inner surface gridded. Precision spaced grids are filled with silver babbitt with a run-in surface of lead-tin alloy 0.002 in. thick electroplated to the bore. Applications are main and connecting-rod bearings on diesel engines and similar heavy-duty services. They operate under loads of over 3500-psi projected area with shafts as low as 160 brinell hardness. Bearing is usually made as half bushings but can be full cylinders. **National Bearing Div, American Brake Shoe Co, St. Louis 10, Mo.**

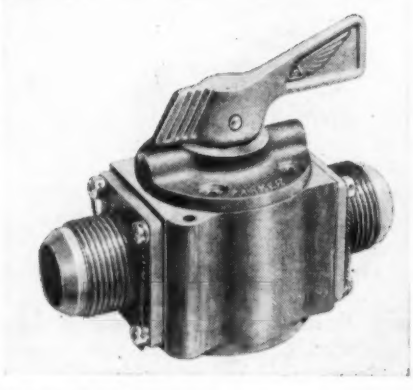


Gearless Pumps E16

DOUBLE-IMPELLER GEARLESS PUMPS, for general industrial application, handle practically any kind of liquid. Bodies are made of stainless steel, monel or bronze to meet wide range of industrial requirements. They are available in ¼- and ½-in. sizes for capacities from 1 to 12 gpm according to pump speed and pressure. Pumps operate at speeds of 200 to 3500 rpm and pressures up to 50 psi, and have self-lubricating bearings. **Eco Engrg Co, 12 New York Ave, Newark 1, N. J.**

Finned Tubes E17

BELL-END FINNED TUBES, generator air coolers, aftercoolers, economizers, and other heat exchangers, are now available. The bell end facilitates retubing through large hole in tube sheet. Serrated fins assure maximum heat transfer. Tubes are available in Admiralty tubing with copper fins solder bonded to tubing. All steel tubes can be supplied for high temperatures. **Fintube Coil Corp, 635 E Garvey Blvd, Monterey Park, Calif.**

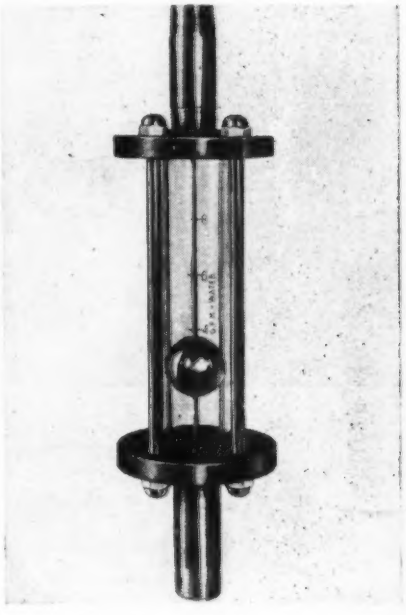


Selector Valves E18

SERIES OF nonlubricated selector and shutoff valves are available for handling air, gas or hot liquids up to 400 F, and at nonshock pressures as high as 500 psi. Valves are available in a variety of metals, and designed with nonlubricated rotors of inert graphite. Valves come in a variety of rotor arrangements, permitting inter-connection of various combinations of as many as five separate lines. They can be furnished for hand or electric-motor operation. Shutoff valves range in size from ½- to 2-in. pipe size, and the selector series ranges from ½- to 1¼-in. pipe size. **Parker Appliance Co, 17325 Euclid Ave, Cleveland, Ohio.**

Distribution Transformer E19

THIS NEW DISTRIBUTION TRANSFORMER has a wound-core of cold rolled, oriented, silicon steel. It also has stud-type sidewall high-voltage bushings with metal-enclosed bushing gaskets and bushing insulating caps. The transformer comes in ratings of 25 kva and below, and voltages of 14,400 v and below. It is a single-phase 60-cycle unit. **Pennsylvania Transformer Co, Box 6208, Pittsburgh 12, Pa.**



Flow Indicator E20

BALL-FLOW INDICATOR provides both a visual indication of flow and an approximate rate of flow. Unit consists of a tapered glass tube with a moving, guided brass ball which acts as the indicator. Ball movement is confined to center of tube by a slender stainless-steel rod. Indicator comes in all standard pipe sizes from ¼ to 2 in. for flow ranges from 0.2 to 60 gpm. It may be connected in series with pumps, filters, water-treating equipment, bearings and cooling or heating jackets to show progressive wear or clogging. **Schutte & Koerting Co, Philadelphia, Pa.**

Automatic Stoker E21

SELF-CONTAINED, traveling-grate stoker, designed for low- and high-pressure heating and industrial loads, burns barley, No. 3

(*Continued on page* 170)

Use convenient reply cards on page 180A to secure additional information on these new equipment items. Please be sure to identify your request with the new-equipment key letter, *E*, and number, as shown on the items above.

Chemical Industries Plants

pick Nalco for permanent water treatment results!

Original research into water treatment problems is an important part of Nalco Laboratories work. Shown here is equipment used for the study of methods to keep boiler plant auxiliaries free from trouble.

Where chemistry is no mystery to plant operating men, the Nalco System thrives . . .

56.3% of all chemical industries plants using the Nalco System have been getting successful water treatment results for more than 5 years!

44.3% of the plants above have used the Nalco System *more than 10 years!*

41.9% of the plants in the over-10-years group have progressed with the Nalco System for *15 years or more!*

Such a record of continuous successful service has a point for you . . . If you are not already getting Nalco water treatment results, it may well be a profitable step to join the men who know chemistry — and stick to the Nalco System. Write for details today.

NATIONAL ALUMINATE CORPORATION

6222 W. 66th Place, Chicago 38, Illinois

Canadian inquires should be addressed to Aluminate Chemicals, Ltd.
555 Eastern Avenue, Toronto 8, Ontario

Nalco — the Scientific System of Water Treatment for All Industry

How to plan a

COMBINATION WET PIPE AND DRY PIPE SPRINKLER SYSTEM

Another in the series of basic piping layouts prepared by Jenkins Bros.

A **TYPICAL sprinkler system** installation for multi-storied buildings is shown in this layout. This system uses both a wet and dry pipe riser. The wet riser supplies sprinkler heads in areas that are maintained at above freezing temperatures, and the dry riser serves the sprinkler heads in unheated parts of the building where pipes might be subject to freezing. Although this system complies with the Underwriters' codes, minor variations may be required by local ordinances, or simply to reduce insurance rates. *Consultation with accredited piping engineers and contractors is recommended when planning any major piping installations.*

Both wet and dry pipe risers are fed from a dead riser which carries the water from the roof gravity tank and/or a pressure tank. In addition to these primary sources of supply, a siamese connection is required for the fire department hose outlet. Individual risers are provided in each system so that ample warning can be given to building occupants. The wet pipe alarm is actuated by the flow of water, while the dry pipe system generally has a low pressure air alarm in addition to the water flow alarm.

In the wet pipe system all pipes are filled with water under pressure. In the dry pipe system the pipes above the dry pipe valve are filled with compressed air and a drop in pressure caused by the opening of a sprinkler head activates the valve, thus allowing water to pass through the open heads.

The important section control valves recommended are Jenkins Fig. 825, Iron Body O.S.&Y. Rising Spindle Gate Valves. They are approved by the National Board of Fire Underwriters and Associated Factory Mutual Fire Insurance Companies.

Copies of Layout No. 30 will be furnished on request. Mail coupon.

Jenkins PRACTICAL PIPING LAYOUTS 30

Illustrating the proved 3-point formula for trouble-free, time-defying hookups

- **A** Use the right type valve for the service.
- **B** Place valves correctly in the line.
- **C** Choose Jenkins Valves for lifetime economy.

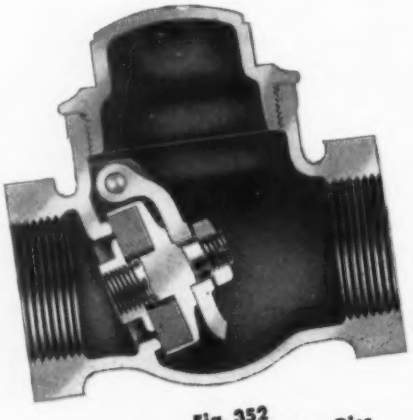


Fig. 352
Renewable Composition Disc
Bronze Swing Check Valve

Used ordinarily in conjunction with gate valves, Fig. 352 offers a comparable full, free flow. Convenient renewable composition disc can be replaced easily without removing valve from the line. Will seat tightly with a differential pressure as low as 2 pounds.

A CHOICE OF OVER 500 JENKINS VALVES

To save time, to simplify planning, to get the advantage of Jenkins specialized valve engineering experience . . . select all valves from the Jenkins Catalog. It's your best assurance of the *lowest cost in the long run.*

Jenkins Bros., 80 White Street, New York 13; Bridgeport, Conn.; Atlanta; Boston; Philadelphia; Chicago; San Francisco.
Jenkins Bros., Ltd., Montreal.

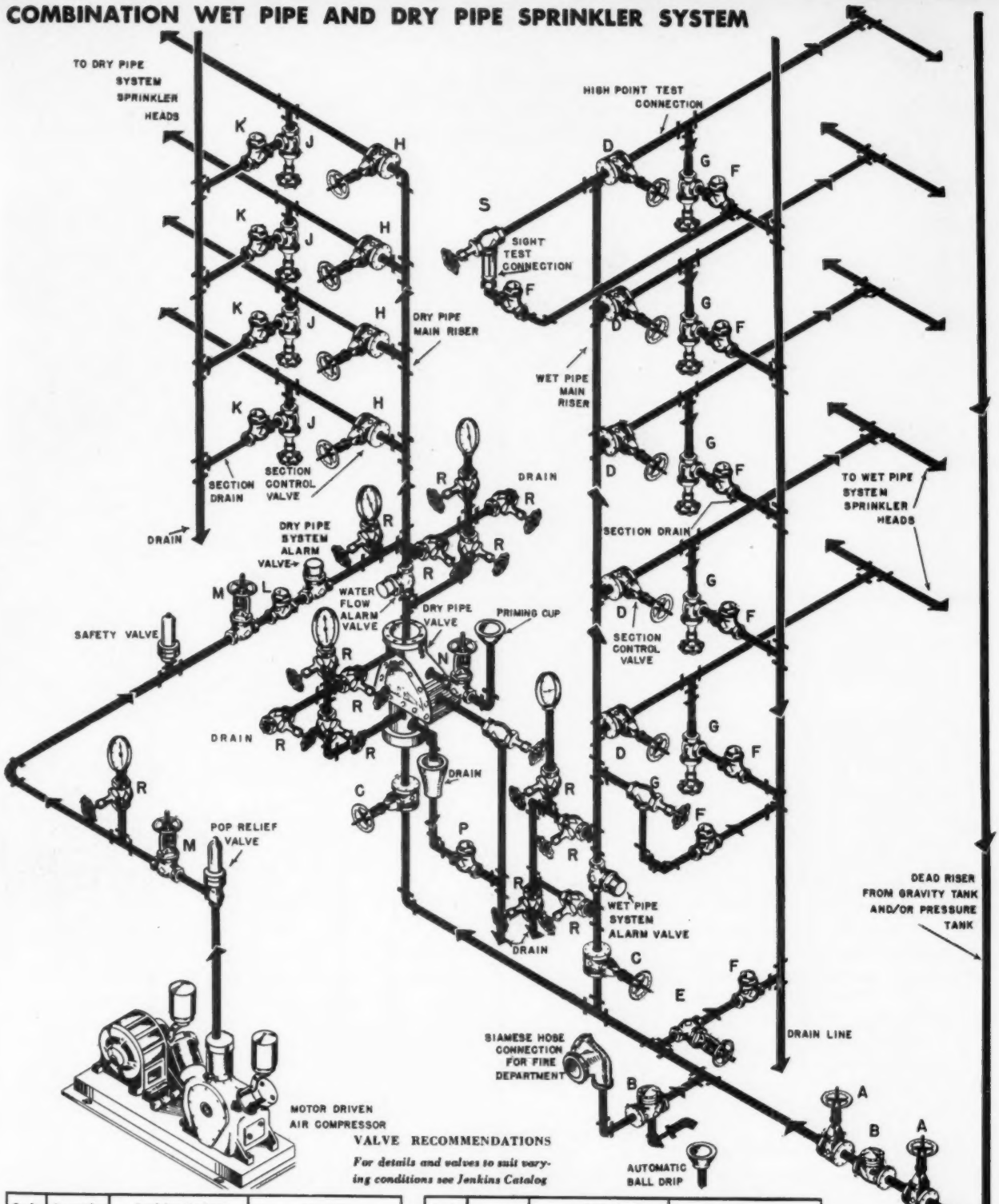
JENKINS VALVES

LOOK FOR THE DIAMOND MARK
SINCE 1864

TRADE JENKINS MARK
Jenkins Bros

125 TO 600 LBS. STEAM PRESSURE

COMBINATION WET PIPE AND DRY PIPE SPRINKLER SYSTEM



VALVE RECOMMENDATIONS

For details and valves to suit varying conditions see Jenkins Catalog

Code	Quantity	Jenkins Valves	Service
A	2	Fig. 825 I.B.B.M. O.S.&Y. Gate	Dead Riser Shutoff
B	2	Fig. 629 I.B.B.M. Swing Check	Prevent Back Flow to Dead Riser
C	2	Fig. 825 I.B.B.M. O.S.&Y. Gate	Dry and Wet Pipe Shutoffs
D	5	Fig. 825 I.B.B.M. O.S.&Y. Gate	Wet Pipe Sectional Control
E	1	Fig.275-U Bronze Gate	Riser Drain
F	8	Fig. 352 Bronze Swing Check	Prevent Backflow from Drains
G	6	Fig. 108-A Bronze Angle	Wet Pipe Section Drain
H	4	Fig. 825 I.B.B.M. O.S.&Y. Gate	Dry Pipe Section Control

Code	Quantity	Jenkins Valves	Service
J	4	Fig. 108-A Bronze Angle	Dry Pipe Section Drain
K	4	Fig. 352 Bronze Swing Check	Prevent Backflow from Drains
L	1	Fig. 352 Bronze Swing Check	Prevent Water Back Up to Air Compressor
M	2	Fig.275-U Bronze Gate	Air Compressor Shutoff
N	1	Fig.275-U Bronze Gate	Priming Water Shutoff
O	1	Fig. 108-A Bronze Angle	Drain of Dry Pipe Valve
P	1	Fig. 352 Bronze Swing Check	Prevent Back Flow
R	13	Fig. 106-A Bronze Globe	Pressure Gage Controls and Drains
S	1	Fig. 108-A Bronze Angle	High Point Test Connection

Diagram by Huxley Madeheim Consulting Engineer

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Number 186

Figuring Refrigeration Capacity

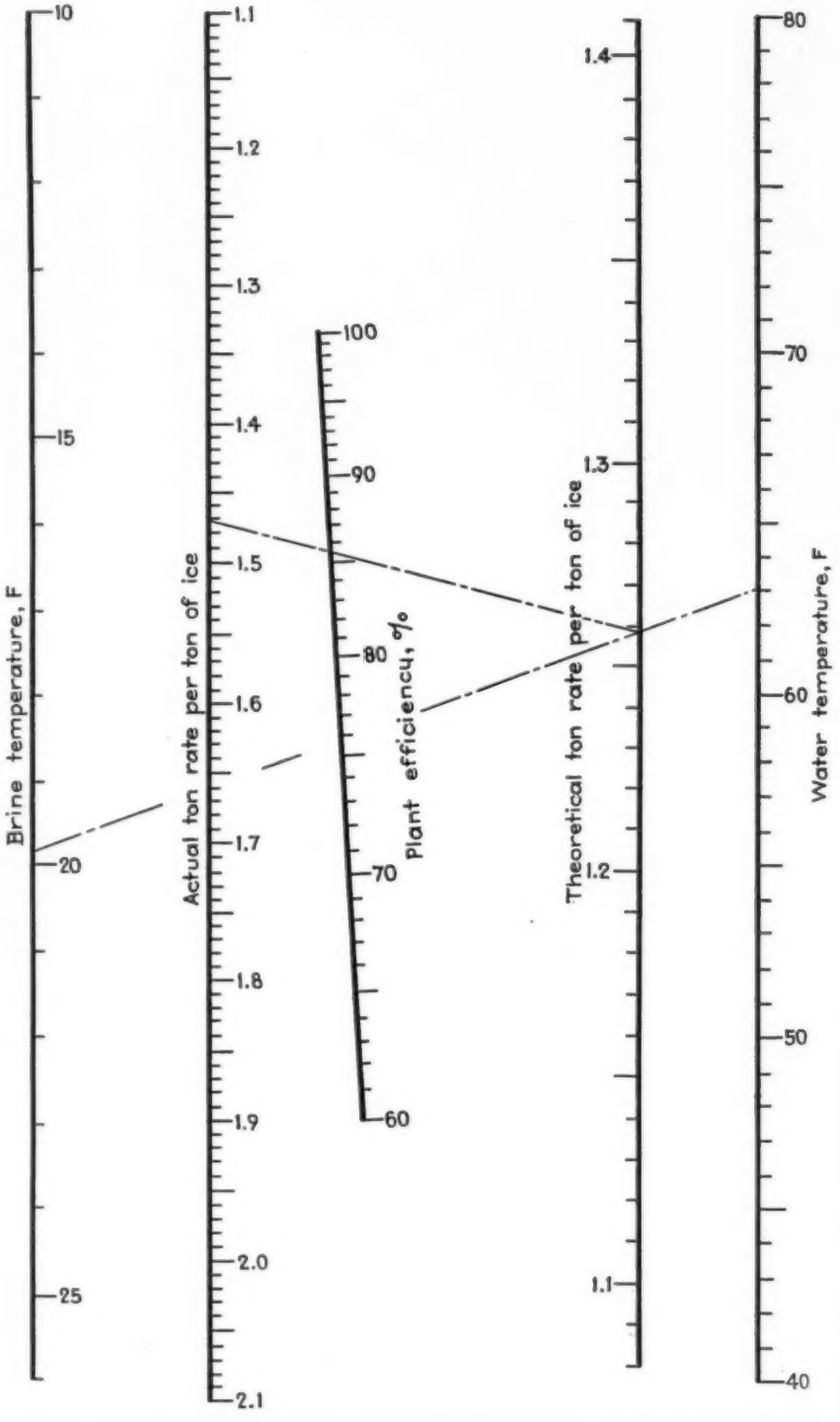
Here's a chart to speed up the calculations needed in routine follow-up of refrigerating-plant performance. To find the actual ton-rate capacity used per ton of ice produced, apply the following formula,

$$\text{Actual ton rate} = \frac{0.5\,(32\text{-}T) + (t\text{-}32) + 144}{144 \times \text{efficiency}}$$

Where
T is the temperature of the brine
and
t is the temperature of the water in degrees F.

Example: Find the actual ton rate per ton of ice output when brine temperature is 19.8 F, water temperature is 63.1 F, and plant efficiency 85.5%. Lay a straight edge from the appropriate numbers on the temperature scales to find the intersection on the theoretical ton-rate scale. Then lay the straight edge from this intersection through the efficiency scale to read the answer of 1.471 actual ton rate per ton of ice output.

By John Hyam



COPES

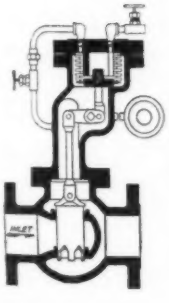
at Jennison Station

means close boiler water level control by COPES Flowmatic on two 675-psi, 825-F Combustion Engineering two-drum steam generators, each rated at 200,000 pounds of steam per hour, largest units in this country stoker-fired with anthracite.

JENNISON STATION, most modern steam plant of New York State Electric & Gas Corporation, is benefitting from close boiler water level stabilization, provided by two-element COPES Flowmatic. Adjusted to carry a higher level on heavy loads than on light, total variation is within plus-or-minus one inch. The story is told in Bulletin 463—Boiler Feed Control at Westover, Greenidge and Jennison Stations. Write—your letterhead, please—for a copy.

NORTHERN EQUIPMENT COMPANY
181 GROVE DRIVE, ERIE, PENNSYLVANIA
Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves and Desuperheaters
BRANCH PLANTS: Canada, England, France
Representatives Everywhere

★ GET CLOSER LEVEL CONTROL WITH COPES FLOWMATIC

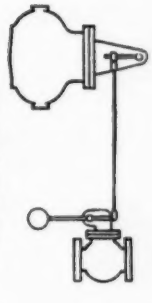


DIFFERENTIAL VALVES

COPES Differential Valves maintain constant pressure drop across the feed water regulator valves, regardless of changes in pump pressure or line friction losses accompanying wide fluctuations in boiler load. Individually designed for each installation. Available in separate bodies, as illustrated, or in combination with the feed water regulator valve bodies.

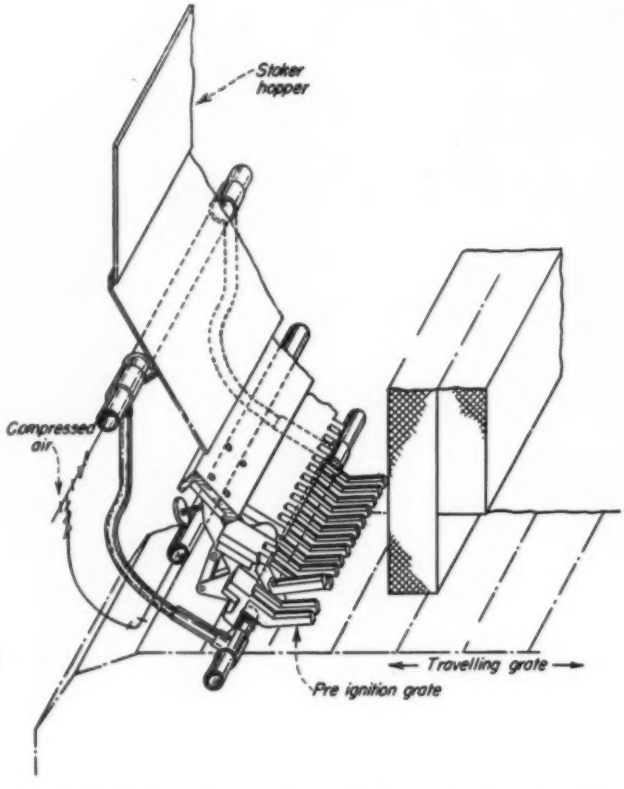
LIQUID LEVEL CONTROL

For control of water or steam input or output, open or closed vessels. For throttling steam supply to fluid pumps. Semi-steel, cast-steel or forged-steel float chambers, with floats of different sizes and materials to meet individual needs. The direct- or relay-operated COPES Valves have low friction, high lift, accurate balance, ports designed for each installation.

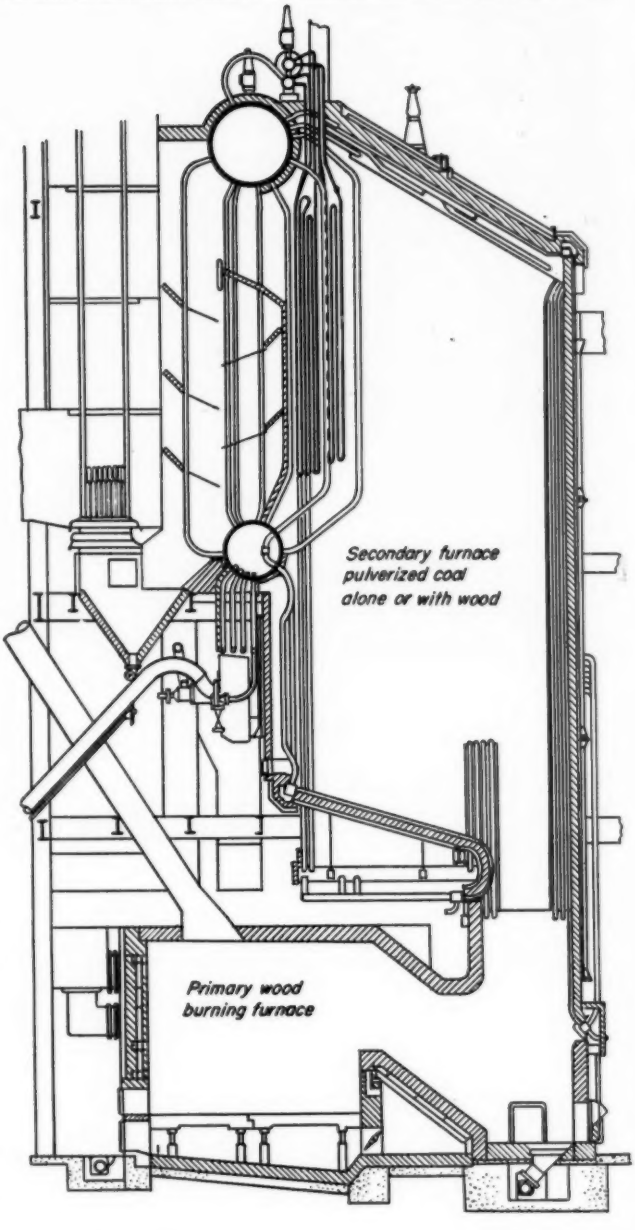


TECHNICAL BRIEFS

ENGINEERING DEVELOPMENTS HERE AND ABROAD DIGESTED FOR BUSY POWER MEN



1 Pre-ignition grate (above), found successful for burning Australian brown coal on traveling grate stokers, consists of short-step grate mounted at the stoker hopper. Compressed-air jets impinge to stimulate ignition



2 Sectionalized furnace for large steam generation from wood refuse has primary furnace for wood; secondary one for pulverized coal alone or combined with wood refuse

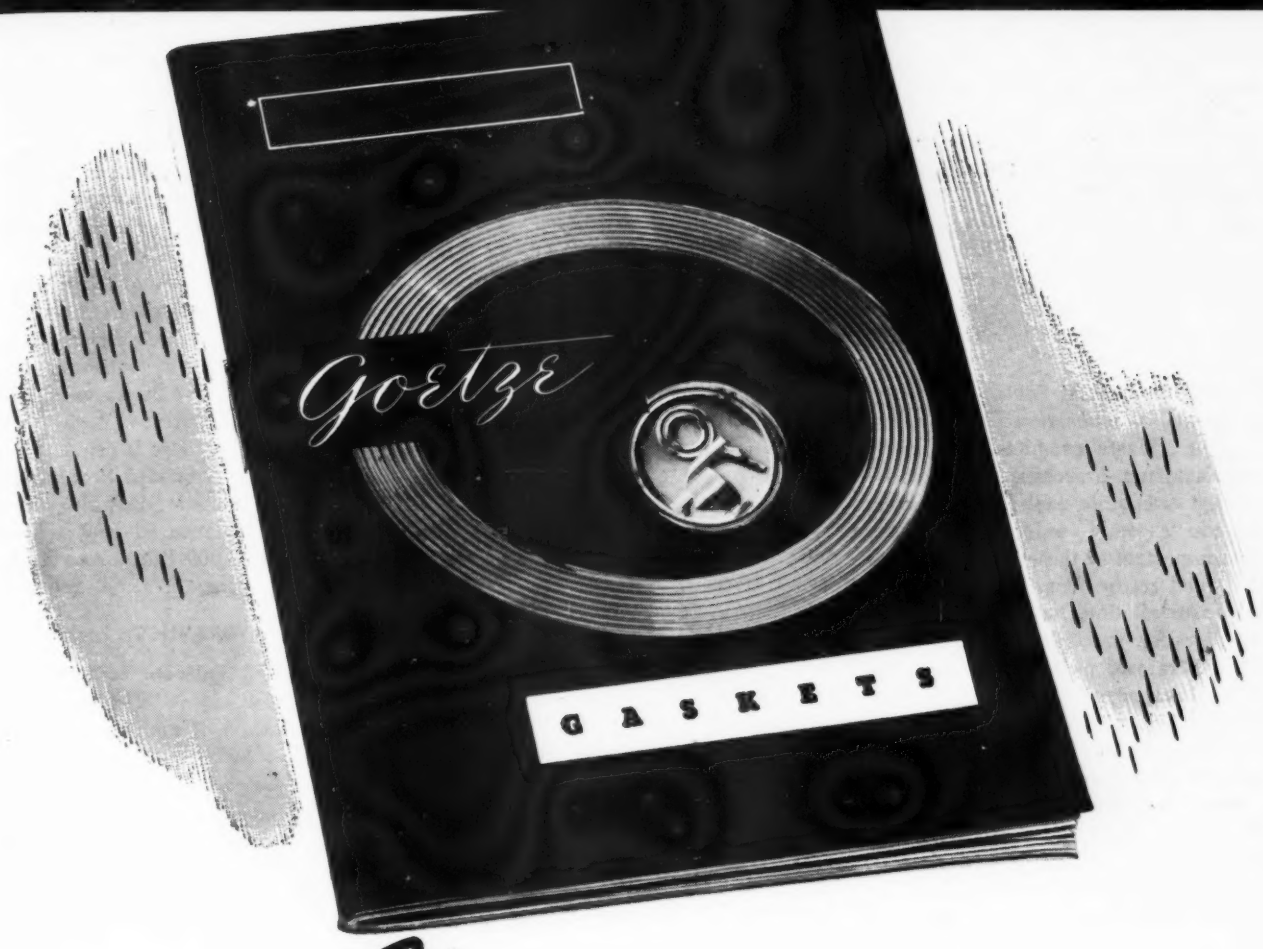
FUEL BURNING

Use of Raw Brown Coal on Industrial Stokers, *by I McC Stewart, J R Nicholson and H P Reinback, Australian National Committee, Fuel Economy Conference.* Brown coal with moisture content of 65% has been successfully burned for many years in large central stations in State of Victoria. Australia. Recent severe shortage of black coals has made this brown coal a necessity in industrial boilers generating under 20,000 lb per hr of steam. Adapting existing stokers required considerable experimenting.

Spreader stokers had no ignition difficulties and the fear of heavy fly-ash emissions did not materialize. A gross grate rating of 600,000 Btu per sq ft per hr resulted from firing unscreened coal, 49% moisture, 2% ash, crushed to about 3-in. maximum size and possessing a high reactivity.

Single-retort underfeed stokers with forced-draft fans can fire brown coal of 59% moisture by using (1) thick fuel beds (2) larger coal quantities per unit of boiler capacity—about three times normal bituminous feeds (3) close control of sizing—fines, ⅛ in. and below, should not exceed 10% (4) larger feed screws or greater screw speed for increased feed rates.

Chain-grate stokers, largest single-firing method in Victoria, experienced severe ignition troubles. A preignition



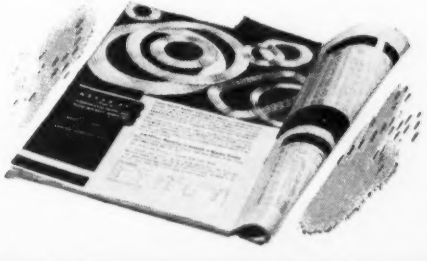
HERE'S THE *News* ABOUT METAL GASKETS

Send for this latest GOETZE GASKET CATALOG, just published by Johns-Manville

Do you want to be fully informed on the latest money-saving developments in the field of metallic gaskets?

Then send for the new 48-page Goetze Gasket catalog just off the press. Now that Goetze Gaskets are a part of the Johns-Manville line, this new catalog reflects the combined experience of two of the oldest and best-known names in gaskets—Goetze and Johns-Manville . . . brings you up to date on the strides that have been made in recent years in the design and manufacture of metallic gaskets. A handy reference chart shows at a glance the many improved Goetze types that are available now to meet your requirements.

If you buy or use metallic gaskets, you'll find the new Goetze Catalog a valuable reference guide. Write, on your company letterhead, for your free copy. Address Johns-Manville, Box 290, New York 16, N. Y.



JOHNS-MANVILLE JM PRODUCTS

grate, Fig. 1, p. 128, consisting of a short step-grate mounted at stoker hopper before the traveling grate, proved successful. Compressed-air jets impinging on coal retained on the step grates stimulated ignition. Crushed run-of-mine coal, 47 to 49% moisture, burns at grate ratings up to 400,000 Btu per sq ft per hr with this important proviso—size segregation is watched carefully. *WPC, Paper No.* 15, *Section C2.*

Furnaces for Special Fuels, *by Otto de Lorenzi, Combustion Engineering Co, Inc.* Waste products from many manufacturing processes are potential low-cost substitute fuels, for instance, byproducts from pulp manufacture. Most important of these byproducts are (1) wood refuse from the wood room (2) spent alkaline liquors from chemical digestion processes.

Wood refuse, particularly bark, requires dewatering by roll or reciprocating press to bring its water content down from 80 to 65%. If the pressed bark and other wood refuse are hogged, a more favorable size develops that allows a more uniform feed and a better combustion. Pre-heated air provides further drying.

Most widely used furnace for burning wet wood refuse is the dutch oven. Adaptations of this incinerator have been made for building a dutch-oven flat-grate steam generator. From this point a sloping-grate design, followed by a secondary furnace for auxiliary fuels, has been developed. Large units sectionalize furnaces with the dutch oven as a primary furnace and a large watercooled secondary furnace, Fig. 2, where pulverized coal may be burned with wood refuse, or alone.

Spent alkaline liquors, arising from the soda or sulphate process of extracting intercellular matter from wood fiber, are burned in recovery units. These units burn organic matter in the furnace and recover inorganic chemicals by (1) fusing to form a smelt in the furnace and (2) collecting any inorganic chemicals carried off with furnace gas. *WPC, Paper No.* 6, *Sec. C2.*

Deposits on External Heating Surfaces of Boiler Systems, *by H E Crossley, Fuel Research Station, Dept of Scientific and Industrial Research, London, England.* Troubles resulting from formation of deposits on external heating surfaces have increased considerably. High-temperature deposits on boiler and superheater tubes occur in three forms: (1) fused, consisting of sintered flyash only (2) bonded, consisting of flyash particles in a matrix composed mainly of alkali salts (3) phosphatic, consisting of masses of phosphate formed by the action on flyash of furnace-released phosphate compounds. Economizer deposits are aggregates of sulphate and phosphate formed from constituents of flyash and called (1) sulphatic with less than 10% phosphate (2) phosphatic with 10% and over phosphate. Air-heater deposits consist of sulphates, derived from flyash, and free sulphuric acid.

Investigations at British power plants indicate a correlation between amount of alkali chlorides in the coal and the severity of boiler deposits. A similar correlation exists between sulphur in coal and air-heater troubles. Neither correlation applies with pulverized-fuel firing.

Sulphur trioxide in flue gas develops this way. Sulphur dioxide is partly oxidized to trioxide in an aerated flame of carbon monoxide. Oxidation is inhibited by methane and various other substances, including volatile organic matter from coal. Large-scale trials showed that burning liquid fuel in the combustion chamber of a stoker-fired boiler alleviated trouble from deposits. *WPC, Paper No.* 3, *Sec C2.*

Spreader Stoker in the U. S. A., *by Royce L Beers, U. S. National Committee, Fuel Economy Conference.* Recent years have seen development of spreader-stoker firing of bituminous and lignite coals within the U. S. Installations run up to unit sizes of 250,000 lb per hr of steam.

Spreader firing embraces a wide range of coals: from lignite of 6700 Btu per lb, 40% moisture, to bituminous of 14,000 Btu per lb.

Feeders are generally of the mechanical rotating-type with automatic metering of coal feed. Small and medium-size installations are of stationary- and dumping-type grates; larger ones, continuous-cleaning grates.

Load change response is rapid. Flexibility compares with oil. Best results come from automatic controls. Furnace volume is large so heat release is kept under 35,000 Btu per cu ft per hr. *WPC, Paper No.* 8, *Sec C2.*

HYDRAULICS

Development of Hydraulic Seals. *W. W. Hagerty, University of Michigan.* Describes a method of sealing a rotating shaft against leakage caused by axial pressure. Essential features of this method of sealing are given, and the theory of viscous-fluid flow in an annulus formed by concentric rotating cylinders is outlined. Test made on several sizes of seals verify the theory. *NCIH paper.*

Temporary Installation of Shasta Turbines at Grand Coulee, *by H. H. Sloane, U. S. Bureau of Reclamation.* To supply power for war industries, two 103,000-hp hydraulic turbines, designed for Shasta power plant on the Sacramento River in California, were installed early in 1942 in Grand Coulee plant on the Columbia River in Washington. At the rated head of 330 ft. discharge of Shasta units equaled 3200 cfs at full gate, compared to Grand Coulee units, full-gate discharge of 4500 cfs. Grand Coulee draft tubes are, therefore, about 40% larger than those for Shasta.

Records show that the two Shasta units performed well in their temporary setting and supplied over 3 billion kwhr. They rated at 75,000 kw, were loaded to 84,000 kw continuously, and when a little extra peak power was needed each unit operated up to 92,500 kw.

These units were returned to Shasta during 1945 and 46. The biggest job in their removal was taking out the temporary concrete that supported the generators and embedded the turbine casings. About 6500 cu yd of concrete were removed. Most of it was broken out in large blocks, some weighing 87 tons. *ASME Paper No.* 47–F–7.

(*Continued on page* 134)

HOW TO OBTAIN COMPLETE TEXT

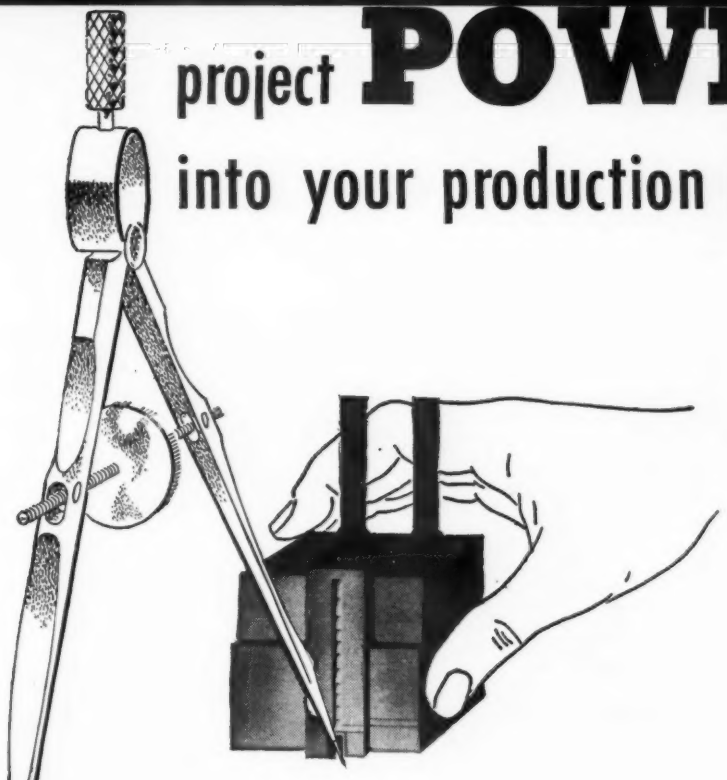
Material appearing in this month's briefs comes from one of these three sources:

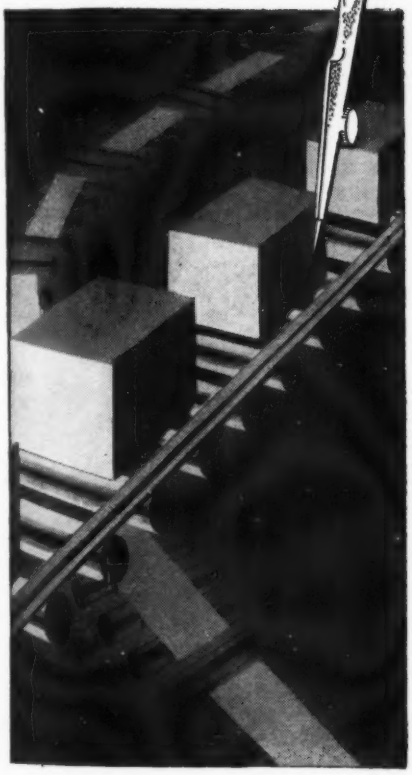
World Power Conference at The Hague in Sept. Papers are identified by the initials *WPC* and the paper No. Supply is limited at the present but will be available in the future.

National Conference on Industrial Hydraulics, Oct 16, 17, 1947. Papers are identified by initials *NCIH.* They are available from the Armour Research Foundation, Technology Center, 35 W 33rd St, Chicago 16, Ill.

American Society of Mechanical Engineers, fall meeting, Salt Lake City, Utah. Sept 1-4, 1947. Papers are identified by initials ASME and paper No. Available while supply lasts at American Society of Mechanical Engineers, 29 W 39th St, New York, N. Y.

project POWER into your production planning





Since modern production planning requires projection of a program over a long period of time it's quite logical that power requirements will be based on a similar long-range study of peak demands for all of the industrial services supplied by modern boiler and power plants.

Because power plant construction, expansion, or modernization does require advance planning *after* your Consulting Engineers have completed their specifications and detail drawings, it's never too early to call in Dravo Power Plant Specialists. When you draw upon Dravo experience during prior planning you can be assured that power and boiler plant construction will be completely integrated with the over-all project—you can schedule your future power requirements and depend upon Dravo to maintain the construction pace to meet those schedules.

There are important advantages to be gained when Dravo contract methods and construction techniques are applied to your power or boiler plant projects. Additional details of these methods and techniques are reviewed in Bulletin GB-504.

DRAVO

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Power and Boiler Plants • Pumping Stations • Power Plant and Contractors' Equipment • Direct-Fired Heaters Industrial Heating and Ventilating • Bridge Substructures • Docks • Pump Houses and Intakes • Mill Foundations Locks and Dams • Shafts, Slopes and Tunnels • Towboats and Barges • Coal and Ore Bridges • Cranes and Derrick Boats • Crane Cab Coolers • Open Steel Flooring • Concrete Aggregates • Inland River Transportation

POWER NEWS

BUSINESS ITEMS • APPOINTMENTS • FOREIGN FIELDS
WASHINGTON NOTES • NEW DEVELOPMENTS • CONVENTIONS

Straws Point Way in Power-Supply Situation

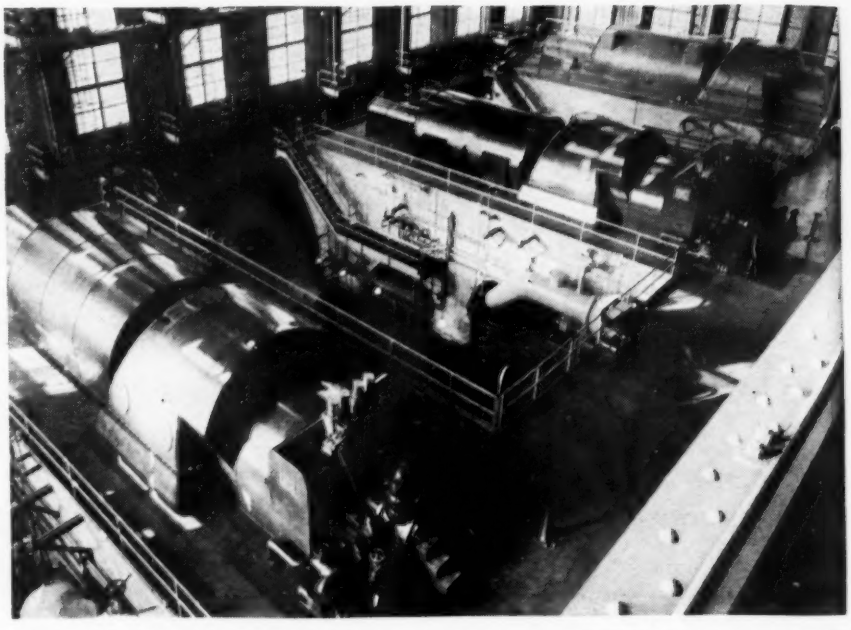
► RECENT DEVELOPMENTS in the power-supply situation in different parts of the country reveal the nature of the problem and some of the means taken to solve it. In this they are like straws that point the way the wind blows.

Working-Hour Shift. In St. Louis, delegates to the AFL Central Trades and Labor Union meeting approved a shift in working hours as a means of avoiding curtailment of industrial operations or a complete shutdown of some plants because of the tight power situation in the area served by the Union Electric Co of Mo.

John I Rollings, executive secretary of the group, stated that together with a CIO representative, he had conferred with Union Electric officials and was advised that unless the company's present power-conservation campaign is successful, St. Louis and vicinity may face a critical situation. Discussions covered the possibility of shifting to off-peak hours industrial operations involving large usage of electricity. While such a shift would interfere with social and economic life of the workers, Rollings expressed the view that this step would be preferable to complete shutdown or the laying-off of industrial workers if the situation worsens.

Delegates approved the Rollings report, which also recommended that AFL unions discuss thoroughly with their employers a shift in operating hours if requested to do so, in the event that the present voluntary electricity conservation program of Union Electric proves unsuccessful. Cooperation in the conservation program was also recommended.

Navy Aids Maine. To reduce power shortage in Aroostook County, Maine, the U. S. Navy ordered, in November, the fitting out of two destroyer-escorts, the *Maloy* and the *Foss*, for use as auxiliary sources of electricity. With suitable transformer equipment, the 3600-kw power plants of these vessels can feed into the Central Maine Power system for transmission to the Medway, Houlton and Presque Isle area by way of the Bangor Hydroelectric Company.



MYSTIC'S THIRD UNIT ON LINE: Boston Edison Co's Mystic generating station at Everett, Mass., reached 150,000-kw capacity on Oct 21, 1947 when the third 50,000-kw General Electric turbine (background, above) went into service. All three machines operate condensing, steam being supplied by Combustion Engineering Co boilers working at 1400-psi drum pressure and 910 F. Continued expansion will bring Boston Edison Co's total capacity to 650,000 kw this year

Drought conditions hit Maine Public Service Co, Presque Isle, so hard that it was forced to divide its system in two parts, rationing service to each on a 2-hr "on" and 2-hr "off" basis. With the potato crop being processed, a considerable loss threatened.

N. Y. Picture Better. Ending of drought conditions, permitting normal flow of power from hydro plants in northeastern New York, led to announcement by New York State Electric & Gas Corp that it has withdrawn its request for power conservation by large industrial customers in the southern tier.

This proved good news for eleven Binghamton-area industrial firms asked

(*Continued on page* 176)

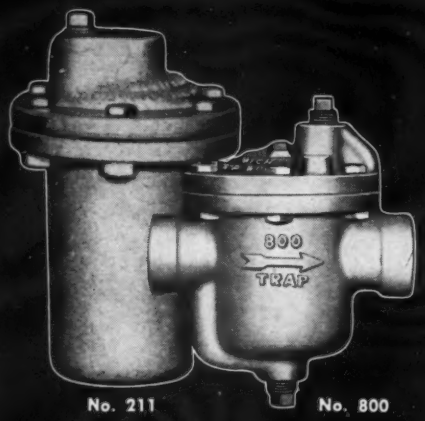
COMING EVENTS

Jan 12-16 — National Materials Handling Exposition, Public Auditorium, Cleveland, Ohio. Clapp & Poliak, Inc, 350 Fifth Ave, New York 1, New York.

Jan 26-29 — Refrigeration Equipment Manufacturers Assn, 5th all-industry refrigeration and air-conditioning exposition, Public Auditorium, Cleveland, Ohio. R Kennedy Hanson, show director, 1107 Clark Bldg, Pittsburgh 22, Pa.

Feb 2-6—American Society of Heating and Ventilating Engineers, 8th international heating and ventilating exposition, Grand Central Palace, New York 17, N. Y. Charles F Roth, manager, International Exposition Co, Grand Central Palace, New York 17.

Mar 1-4 — American Society of Mechanical Engineers, spring meeting, St. Charles Hotel, New Orleans, La. Ernest Hartford, executive assistant secretary, 29 W 39th St, New York.



No. 211 No. 800

Above left — Armstrong bottom inlet—top outlet series trap.

Above right — Armstrong No. 800 side inlet—side outlet trap.

PROOF THAT ARMSTRONG TRAPS PAY DIVIDENDS:

½ TON COAL SAVED daily at American Snuff Co., Clarksville, Tenn., with 12 No. 813 traps on tobacco drying kiln. Also ½ hour faster heating up.

●

15% FUEL SAVING, 62% less maintenance with Armstrong Traps at Grove City Floral Co., Grove City, Pa.

●

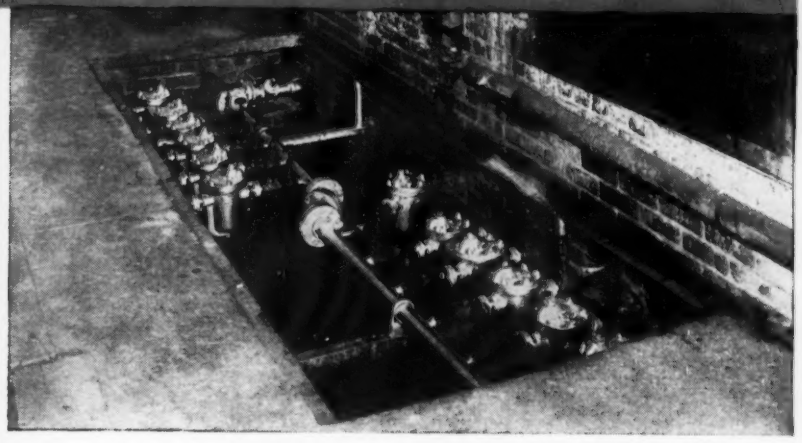
30% LESS fuel consumption, 65% LESS water consumption, and more extraction of oil from material being crushed, after use of Armstrong traps.—Pacific Nut Oil Company, Los Angeles.

●

ONE BOILER INSTEAD OF TWO used after installing Armstrong traps. Also 30-ton-per-month saving in fuel.—Daniel Bassi and Co., Buenos Aires, Argentina.

For Fuel Savings and Maximum Production

SELECT THE CORRECT STEAM TRAP FOR THE JOB!



In order to maintain high temperatures, high production and minimum fuel consumption it is essential that steam traps be correctly selected for each piece of equipment in your plant. Don't select traps by pipe sizes alone. Here's a convenient check list for proper trap selection:*

1. DOES THE TRAP HAVE ADEQUATE CAPACITY FOR PEAK LOADS? Traps should have the capacity to take care of the above normal condensate loads encountered in starting up cold equipment. This will often save hours of warming-up time and greatly increase production.

2. DOES THE TRAP *ACTUALLY* HAVE THE CAPACITY CLAIMED FOR IT? It is possible to unknowingly buy a trap with insufficient capacity. This limits production and wastes fuel. Armstrong trap capacities are very conservatively based on *actual* tests with hot condensate, and a liberal safety factor is recommended. If you follow Armstrong recommendations the traps will handle any condensate load that will be encountered.

3. IS THE TRAP SUITABLE FOR THE PRESSURE? A trap won't work satisfactorily at a steam pressure above that for which it is designed. (In switching traps from one location to another, be sure they are not put on a line with a pressure above their rating.)

4. DOES THE TRAP HAVE ADEQUATE AIR-HANDLING CAPACITY? Air (always present in steam) reduces heat transfer efficiency, lowers temperatures and slows up production. Armstrong traps discharge all normal amounts of air along with condensate.

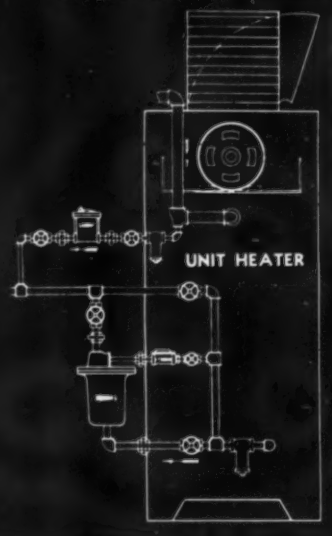
5. DOES THE BODY STYLE PERMIT THE MOST EFFICIENT INSTALLATION? Correct installation, essential to efficient trap performance, is simplified and reduced in cost by the choice of Armstrong trap body styles: No. 800 Series side inlet—side outlet; No. 801 Series side inlet—bottom outlet, and No. 200 Series bottom inlet—top outlet.

*The 36-page ARMSTRONG STEAM TRAP BOOK gives complete data on trap selection and installation on all classes of equipment. Send for your copy. ARMSTRONG MACHINE WORKS, 812 Maple Street, Three Rivers, Mich.

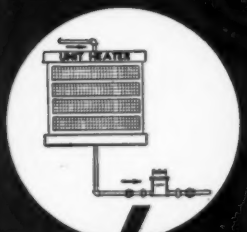
ARMSTRONG *Inverted Bucket* STEAM TRAPS

No. 2 of a series of advertisements devoted to improving efficiency through better trapping.

MORE HEAT · FASTER WITH LESS FUEL!



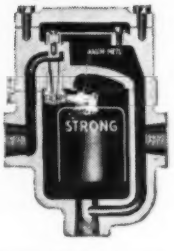
Floor type heater with Strong 70 Series trap draining inlet line, and Strong 80 Series trap with thermal air valve draining heater. *Note strainers ahead of traps.* OVERHEAD HEATER (circle) drained by Strong 170-T trap, with built-in thermal vent.



Accumulated condensate and trapped air can make unit heaters slow in starting. Uncertain drainage will seriously reduce heat output.

LEAKY TRAPS WASTE FUEL

While *all* Strong Inverted Bucket Traps will handle large amounts of air, the hookups shown here provide thermal air vents for practically instantaneous heating. Use of Strong traps, guaranteed for a year against leakage, insures positive drainage without waste of steam.



Strong 170-T trap with integral thermal air vent and newHi-CAP °Orifice. Available in sizes from ½" to 1¼".
°Reg. Trade Mark

Completeness of the Strong line enables us to recommend exactly the right type and size of trap you need—open or inverted bucket, closed float, float-and-thermostatic (blast), etc.—semisteel, cast, forged and welded construction. Send your drainage problems to us for the *right* solution.

STRONG, CARLISLE & HAMMOND COMPANY
1392 West 3rd Street
Cleveland 13, Ohio
ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

Reducing Valve

No. 80 Series Trap

Strainer

STRONG

Generator Exciters

(*Continued from page* 73)

voltage back to normal.

At very low voltages, current in capacitance and reactance circuits differs appreciably. This means that if conductors *A* and *B* of the turbine-generator are short circuited the potential transformer voltage is extremely low. The regulating equipment still provides an additional voltage to cause the rototrol pilot to boost the excitation on the main exciter in an attempt to bring the ac terminal voltage back to normal.

Higher Voltages. Direct-connected turbo-exciters in capacities up to 300 kw at 250 v can be built readily. Above these ratings, a higher voltage is preferable to simplify current collection and to reduce the size of collector rings, thus simplifying operation and reducing maintenance. The largest 3600-rpm turbine generator contemplated now is 150,000 kw, which requires about 400-kw excitation.

Adoption of 375 v as a new standard excitation voltage introduces no problems for either exciter or ac generator as it is in the same insulation class as the present lower voltages. The excitation voltage for machines, 12,500 kw and smaller, is 125 v; for larger machines 250 v is standard.

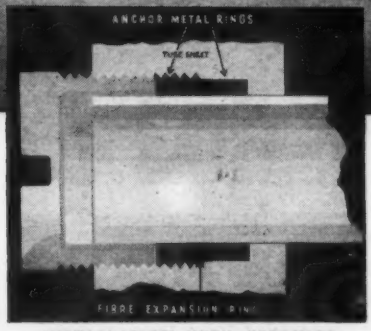
Technical Briefs

(*Continued from page* 130)

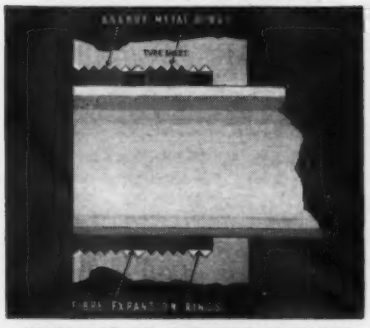
The 103,000-Hp Turbines at Shasta Dam, *by J F Roberts, Allis-Chalmers Mfg Co.* Gives the engineering features of these units, which are rated 103,000 hp at 330-ft net head and 50,000 hp under 238-ft minimum head. Best efficiency, 93.2%, is between 380- and 400-ft net head. They operate under an extreme head variation from 238 minimum to 475 ft maximum; that is, from 72 to 144% rated head. At maximum head the turbines are estimated to be good for 187,000 hp each.

Spiral casings for these turbines are welded plate steel made in seven sections with riveted field joints held by double butt straps. Plates are 1⅞ in. thick in the inlet section, which is 12 ft, 8 in. inside diameter. These are among the first and the largest welded plate-steel scroll cases built in this country. After assembling and riveting in the field, each casing was pressure

"ANKORITE" SURFACE CONDENSER TUBE PACKINGS



INSTALLATION WITH FERRULES



INSTALLATION WITHOUT FERRULES

SAVE LABOR
LONG WEARING
NO LEAKS!

"ANKORITE" Metallic and Fiber Ring Combination holds condenser tubes free from leakage, with or without ferrules. Not affected by fresh or salt water or sewerage contamination.

Metal rings bond the tubes to tube sheet and aid in preventing electrolytic tube destruction.

COMPLETE INSTALLATION INSTRUCTIONS UPON REQUEST

THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

FACTORIES: MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

BRANCH OFFICES

Gay and Lombard Streets	Baltimore 2, Maryland
150 Causeway Street	Boston 14, Massachusetts
Andrews Building	Buffalo 2, New York
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900 South Wabash Avenue	Chicago 5, Illinois
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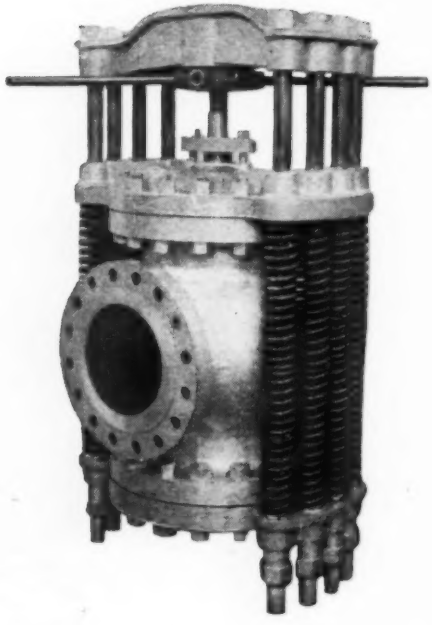
642 Beaubien Street	Detroit 26, Michigan
309 Washington Avenue	Houston 2, Texas
720 Mateo Street	Los Angeles 21, California
3575 Cote St. Paul Road	Montreal 20, Canada
418 Common Street	New Orleans 4, Louisiana
100 6th Avenue	New York 13, New York
401 North Broad Street	Philadelphia 8, Pennsylvania
405 Penn Avenue	Pittsburgh 22, Pennsylvania
Terminal Sales Building	Portland 1, Oregon
156 South Park	San Francisco 7, California
2207 1st Avenue South	Seattle 4, Washington
1407 Pine Street	St. Louis 3, Missouri
921 South Richmond Street	Tulsa, Oklahoma
524 Avalon Boulevard	Wilmington, California

A VALVE THAT WILL INTEREST EVERY POWER ENGINEER



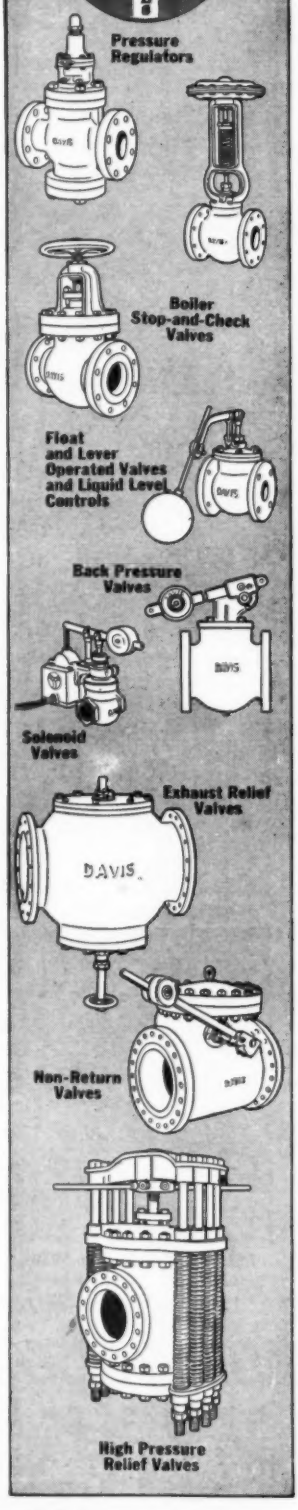
The DAVIS No. 265 HIGH PRESSURE RELIEF VALVE

USES. —(1) For turbine relief on bleeder system. (2) For protection of any boiler room or process equipment by relief to atmosphere. (3) For relief of high pressure lines to low pressure lines at predetermined pressure. (4) For use in plants carrying multiple boiler pressures to protect lower pressure systems.

ADVANTAGES. —Multiple springs result in less spring accumulation . . . less build-up for maximum relief . . . less blowdown to close. Compact design with springs at sides reduces headroom requirements. Center adjusting screw available for quick, easy change of pressure setting.

BUILT TO MEET YOUR REQUIREMENTS. Offered in sizes from 4" to 30" in semi-steel or steel with bronze or stainless steel trim. Test lever and hold-open device available when desired. Detailed information on request.

DAVIS VALVES



DAVIS REGULATOR CO.

Representatives in All Principal Cities

2540 S. WASHTENAW AVE., CHICAGO 8, ILL.

ft maximum net head. *ASME Paper No. 47–F–4.*

Fundamentals of Hydraulic Governor Operations, *by G Forrest Drake, Woodward Governor Co.* The problem of speed control of prime movers is considered briefly. Various speed-sensing devices and servomechanisms are described, and the choice of centrifugal ball-head and hydraulic servos discussed. Included are typical combinations of these elements plus necessary stabilizing devices. Application of hydraulic governors to various prime movers is described as are some unusual installations, such as aircraft-propeller and wind-turbine control. *NCIH paper.*

Hydraulic Circuits of Industrial Process Controls, *by H Ziebolz, Askania Regulator Co.* Calls attention to the similarity between the problems of tool and process hydraulic controls. Analyses are given of basic amplifiers, transients, stability, basic design features, servos, translators for different variables, remote controls, program controls, interlocks and safety features. *NCIH paper.*

Fundamental Aspects of Cavitation, *by Hunter Rouse, Iowa Institute of Hydraulic Research, State University of Iowa.* Cavitation—the tendency of a flowing liquid to vaporize in zones of low pressure—is discussed as a basic phenomenon of fluid mechanics. The relationship of cavitation research in various fields—fluid machinery, supersonics, underwater ballistics, and hydraulic structures—is described, to emphasize both the general nature of the problem and the advantage of cooperative endeavor. *NCIH paper.*

Cavitation in Centrifugal Pumps, *by R M Watson, Worthington Pump & Mach Corp.* Cavitation in centrifugal pumps has long been a matter of concern to manufacturers and users of such equipment. Erosion of pump elements, noisy and unstable performance have been studied to determine: (1) limiting conditions of operation for which careful design can produce a pump free of cavitation (2) nature of cavitation and of materials best suited to withstand its destructive effects.

Particular attention is given to the many factors that cause what might be called premature cavitation, such as local surface defects due to casting departures from ideal shapes, entrance conditions causing a flow pattern not anticipated, leakage jet past wearing rings from discharge to suction, and nonuniform flow in the impeller caused

How to CHOOSE a STEAM TRAP

This 40 page book tells how to select the right size of trap for: unit heaters, header drips, coils submerged or in still air, mains, autoclaves, water heaters, special equipment and many others. Tells how to determine lift of a trap; what are best trapping practices and accepted theories; gives operational and maintenance facts and tips. Part of the book tells about simplified piping and . . .

HOW TO SAVE SCARCE FITTINGS

use Super-Silvertops and save 7 fittings per trap

You can save as many as seven pipe fittings per trap by using Anderson Super-Silvertops. These dependable time-tested, inverted bucket steam traps conserve hard-to-get fittings and save up to 60 minutes of installation time on every trap. Guided bucket design with all connections made at the head of the trap are responsible for these savings—savings obtained without the use of cored passages and split (pierced) gaskets. Send for your copy of the book "How To Choose A Steam Trap" —it's helpful, valuable, shows the way to savings and does not obligate you in any way.

THE V. D. ANDERSON COMPANY
1934 West 96th Street • Cleveland 2, Ohio

and here's how

Super-Silvertop showing one nipple and one union needed.

Conventional trap using seven fittings and two unions.

SUPER-SILVERTOP
STEAM TRAPS

Best way to get supplies fast

Air Express is the fastest possible way to get the supplies and equipment you need. That's because your shipments go on *every* flight of all the Scheduled Airlines. No waiting around. And Air Express packages are picked up and delivered right to your door at no extra cost.

This speedy service helps your business *keep moving* — lets you serve your customers better. Coast-to-coast delivery overnight is now routine. And with *low* rates, there's profit for you in Air Express. Use it regularly!

Specify Air Express-World's Fastest Shipping Method

- Low rates — special pick-up and delivery in principal U. S. towns and cities at no extra cost. • Moves on all flights of all Scheduled Airlines.
- Air-Rail between 22,000 off-airline offices.
- Direct air service to and from scores of foreign countries.

True case history: Electric switches located in Tulsa, Okla., were wanted in Newark, N. J., to complete equipment and fulfill contract date. **21½** lb. package picked up the 17th at 5:05 P.M., delivered 3:35 A.M., just 10 hours later. **1239** miles, Air Express charge only **$8.10.** Other weights, any distance, similarly inexpensive and *fast.* Just 'phone your local Air Express Division, Railway Express Agency for fast shipping action.

AIR EXPRESS
AIR EXPRESS
GETS THERE FIRST

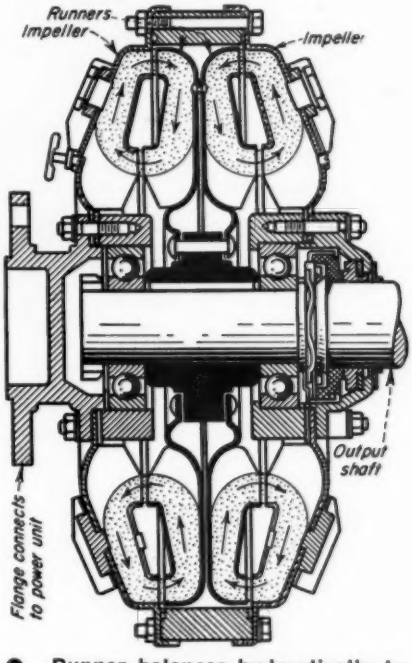
Rates include pick-up and delivery door to door in all principal towns and cities.

AIR EXPRESS, A SERVICE OF RAILWAY EXPRESS AGENCY AND

THE SCHEDULED **AIRLINES** OF THE UNITED STATES

ditions under which pumps operate in process service, as in chemical plants and oil refineries and in condensate service, such as in steam plants, are analyzed. *NCIH paper.*

Practical Hydraulic - Coupling Design Modifications, *by W F Shurts, Twin Disc Clutch Co.* Considers practical aspects of design and application of hydraulic couplings and hydraulic torque converters to industrial equipment. Typical one shows in Fig. 3. Dif-



3 **Runner balances hydraulically by action of two separate axial forces**

ferent designs of hydraulic-coupling circuits and their modifications are explained. Their performance curves are shown for induction motor and internal-combustion-engine application. *NCIH paper.*

Variable-Speed Hydraulic-Power Transmissions, *by James Robinson, Vickers, Inc.* Variable-speed hydraulic-power transmissions using positive-discharge variable-displacement piston pumps are studied for speed range, physical size, rating, hydraulic circuits, volumetric efficiency, fluid compressibility, output torque, torque efficiency, pump-stroke control, noise levels, failure of hydraulic equipment to perform, and operating temperature range. These factors indicate that requirements should be carefully analyzed before selecting a variable-speed unit, to obtain best possible application of hydraulic equipment. *NCIH paper.*

Hydraulic Fluids and Their Applications, *by James I Clower, University of Dela-*

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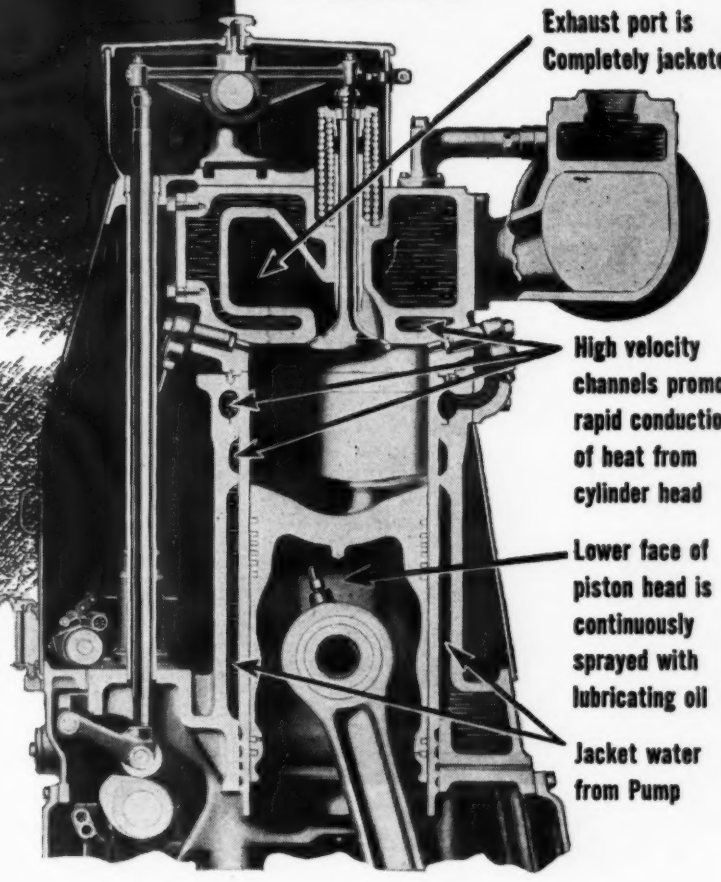
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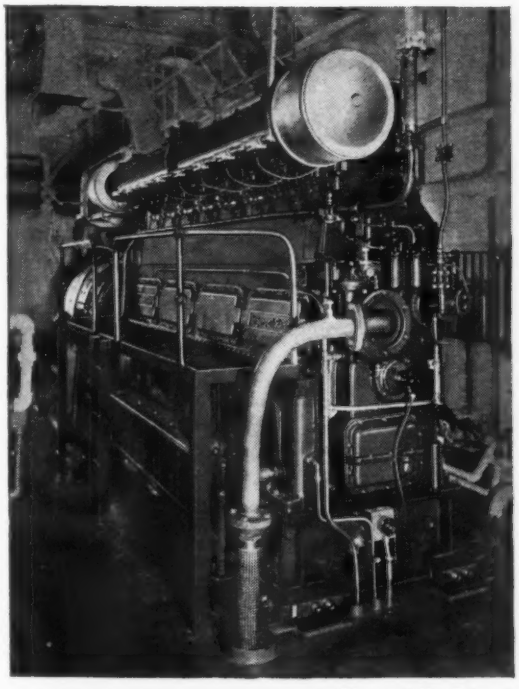

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ware. Hydraulic fluids are being used at an accelerated rate to actuate virtually every type of mechanical device. They are being utilized in installations considered only a few years ago to be impracticable. Their diverse use is due mainly to the smoothness of operation, flexibility and accuracy of control and the characteristic that high pressure may be generated at one point and transmitted to another for use with minimum loss.

Full realization of the advantages of the application of hydraulics depends on the system's design and the use of correct fluid. Hydraulic-equipment manufacturers are constantly seeking improvements in design and increasing the scope of application. Fluid manufacturers are keenly interested in these developments and are constantly striving to keep abreast of them. As a result, hydraulic systems and fluids are dynamic and not static. This paper presents: (1) fundamentals of hydraulic systems (2) operating conditions (3) characteristics, uses and selection of hydraulic fluids (4) maintenance and care of systems and fluids (5) hydraulic-fluid recommendations (6) operating notes. *NCIH paper.*

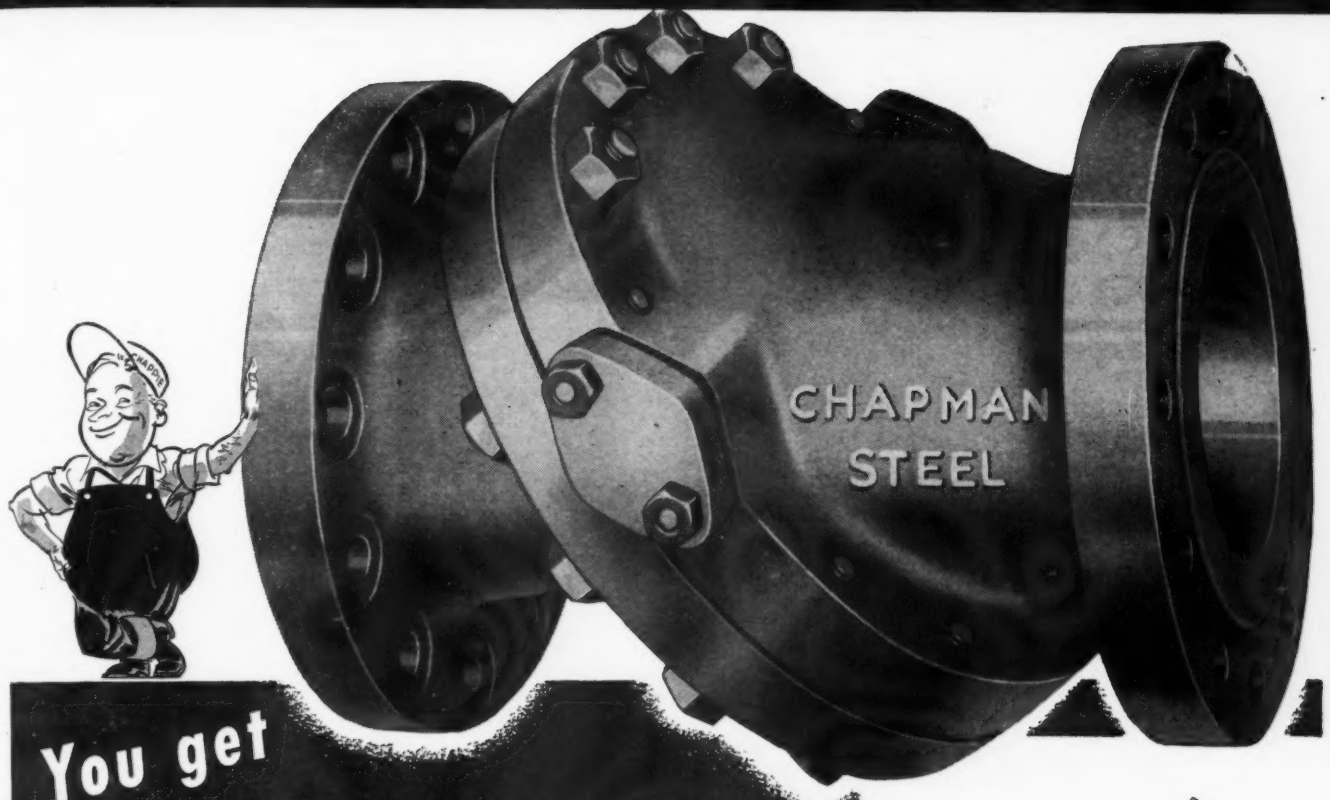
Hydrogen Zeolite

(*Continued from page* 101)

This corresponds to 1 ppm of free mineral acidity.

Suggested Procedure. Although the boilers are now regularly cleaned by washing as described, this procedure is not advocated as a criterion for every plant. Washing time varies with size of boiler, free mineral acidity of the water and character of the scale or sludge deposits. If other engineers wish to try the method they should make tests to determine best rate of circulation and the time required, because free mineral acidity from hydrogen-zeolite softener varies with the chloride and sulphate content of the raw water. Some supplies, such as water from the Great Lakes, have only 20 to 30 ppm of chlorides and sulphates, which gives a correspondingly low free mineral acidity in the zeolite effluent. With such waters a higher rate of washing and longer contact time should be used. If chlorides and sulphates are higher than represented in Table I, the effluent from a hydrogen-zeolite softener will have higher acidity and rate of reaction on scale and boiler metal be more active.

(*Continued on page* 142)



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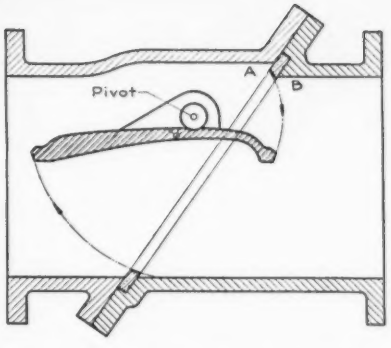

Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

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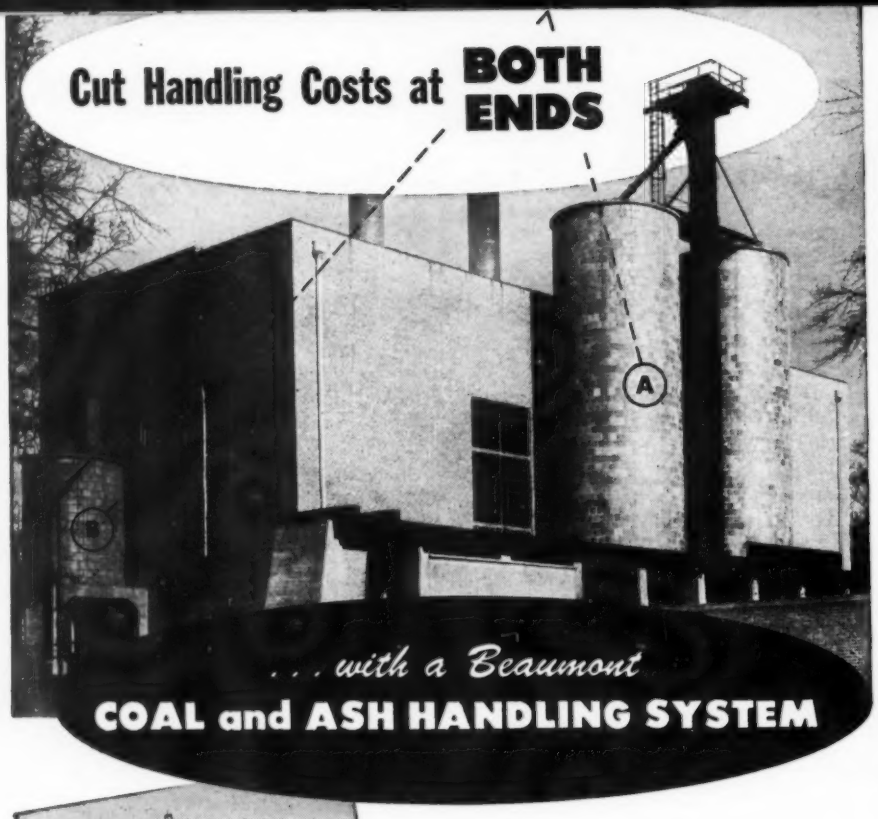

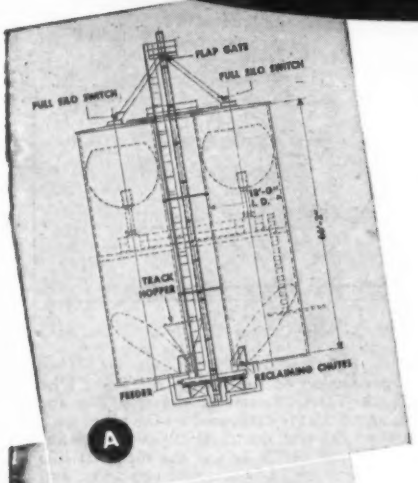

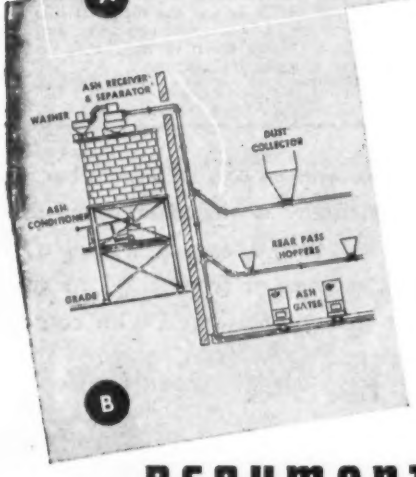

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DISCUSSION BY POWELL

EDITOR'S NOTE: *In the following paragraphs, Sheppard T Powell, consulting chemical engineer, discusses the above article, "Hydrogen-Zeolite Treated Water Dissolves Boiler, Superheater Scale."*

I have followed with much interest the process of cleaning boilers with acid water from hydrogen-zeolite units. When, in the official capacity of utility consultant to The Reconstruction Finance Corporation, Office of Rubber Reserve, the process was first brought to my attention, I hesitated to approve it until sufficient evidence was presented to ensure that the boiler and appurtenant equipment would not be damaged. The desired tests were conducted, and the results indicated that no particular damage would occur if proper precautions were taken. Further, it appeared that the rate of attack on the steel under controlled treatment would be no greater when using the dilute uninhibited acid water from zeolite units than when employing a stronger acid solution to which an inhibitor had been added.

Under some conditions it is probable that the cleaning process described by the authors will be effective and economical to carry out, but it cannot be claimed to be adaptable to cleaning all types of boilers, nor can it be suitable for removing or dissolving many types of scale. It will not remove many types of siliceous scales, nor is there any assurance that it can effectively or economically remove adherent deposits of black iron oxide.

Operators who desire to clean boilers this way should realize the hazards involved which are much the same as those experienced with any form of acidizing. There is always the potential danger of explosion from hydrogen generated by the reaction between acid and iron or steel unless steps are taken to remove the gas. Further, if temperatures are not properly controlled (below 140 F) or if precautions* are not taken to neutralize all residual acid with an alkali after cleaning is completed, damage to equipment may occur.

Give special attention to the danger of pocketing acid or hydrogen gas in superheater tubes. This is especially important when attempting to acid-clean nondraining superheaters.

In the final analysis, the process of cleaning boilers, as suggested by the authors is ingenious and, when it is properly applied and the work carefully supervised, it may have merit. It is a procedure that should not be carried out

* Refer to "Acid-Cleaning of Boilers and Auxiliary Equipment," by Sheppard T Powell, *Transactions, ASME*, November 1946.

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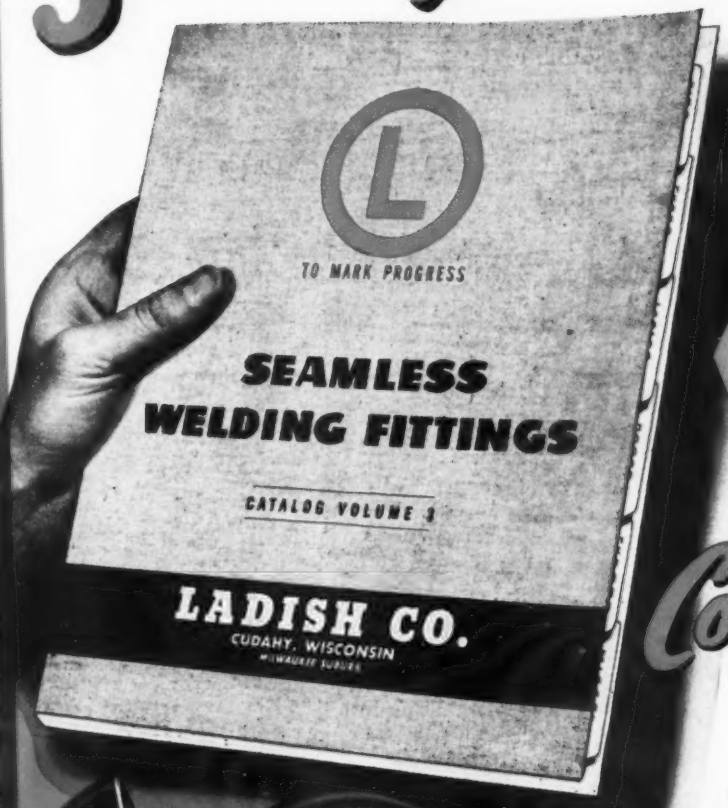

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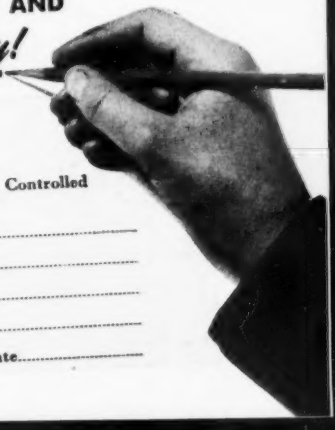

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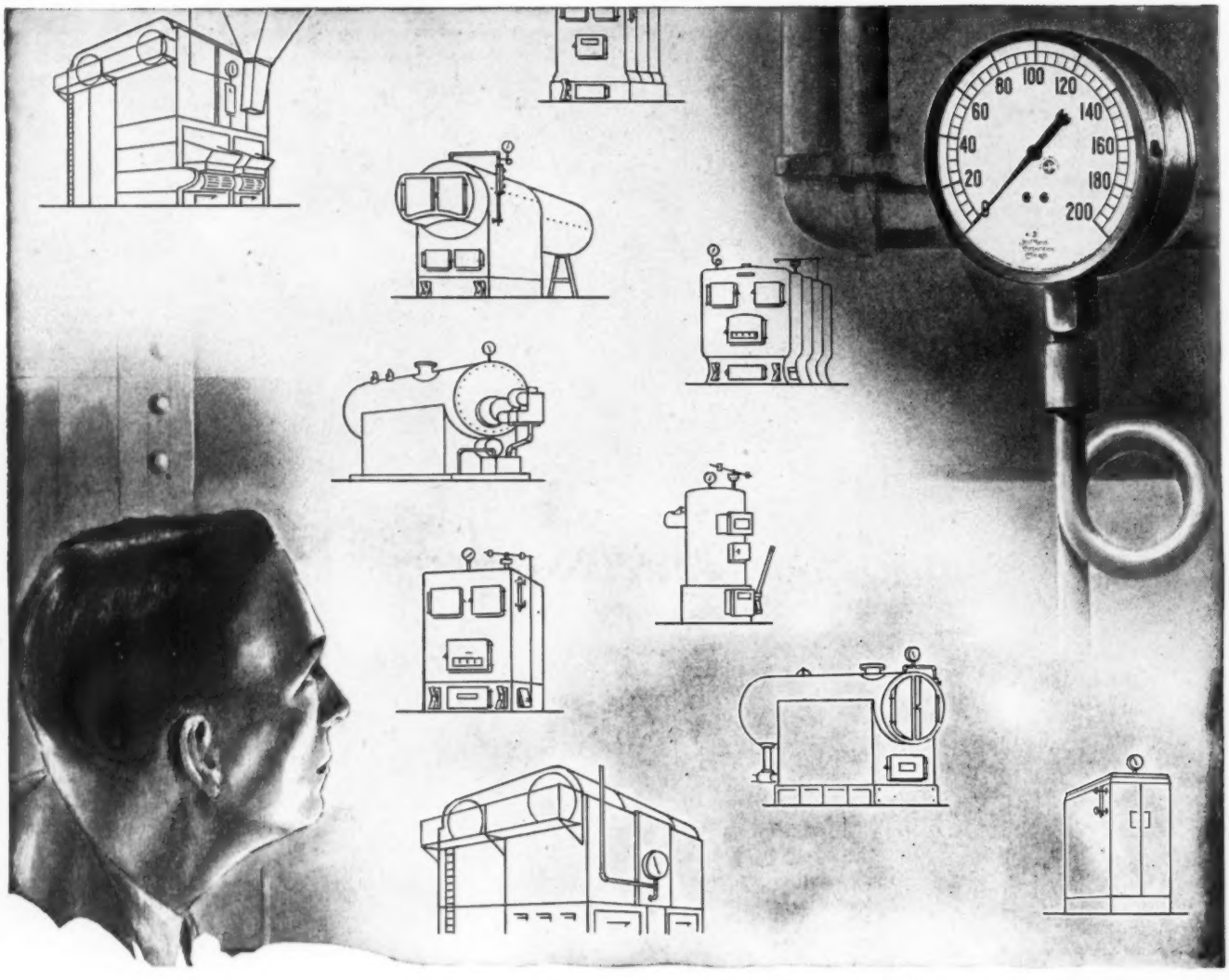

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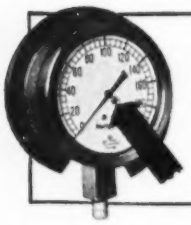

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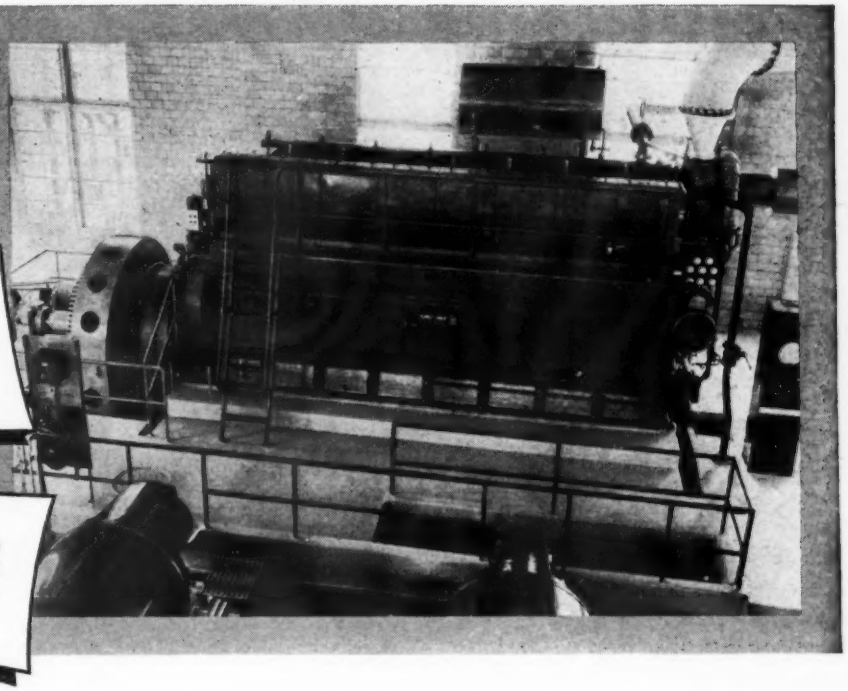

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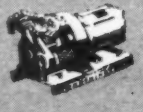

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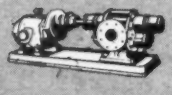

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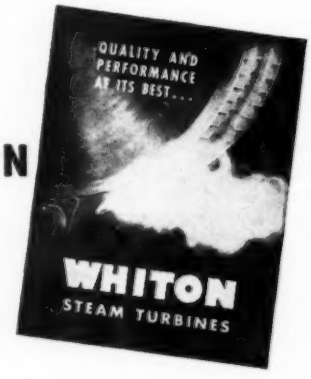

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promiscuously or attempted except under meticulous control. Operators should be fully acquainted with the procedure and all the inherent hazards present during acid cleaning of any type.

Pumps Q and A

(*Continued from page* 108)

case is equipped for connecting to the shaft-enclosing tube and a vent included. A bearing lubricated by the pumped liquid is located below the vent. A second bearing lubricated through the shaft-enclosing tube is located above the vent.

Q 17—What purpose does the vent serve and why are bearings located above and below it?

A—In an enclosed-shaft pump, vent and adjacent bearings serve the same purpose as the stuffing box of an open-shaft pump. Maximum pump pressure develops at the top impeller. The bearing, just above this impeller but below the vent, operates with close clearances to reduce leakage and keep full pressure from the vent. The latter drains leakage back to the well and prevents subjecting the bottom end of the shaft-enclosing tube to pressure.

Above the vent, the bearing also operates with close clearance, and serves to keep vent pressure, if any, from the enclosing tube. This bearing is usually threaded and couples the bowl to the shaft tube. Any lubricant that passes through this bearing is drained through the vent. Both bearings are vulnerable in abrasive liquid so packing may be used to break down the pressure and limit liquid flow through the bearing clearances.

Q 18—What thrusts are developed and how are they controlled?

A—Radial thrusts are negligible. Hydraulic radial forces are distributed equally in these diffuser pumps, and the rotating parts are mechanically balanced. Sleeve bearings maintain shaft alignment.

Vertical thrust is due to a combination of these factors: (1) Vertical turbine-pump single-suction impellers are unbalanced axially and develop a downward hydraulic thrust. (2) Impeller and pumpshaft weight adds to vertical thrust. (3) Lineshaft weight.

Thrust bearings in the driver carry the total vertical load.

Q 19—What is the pump's driver?

A—A driver may or may not be the prime mover. It is the mechanism

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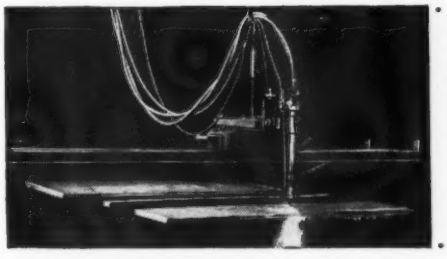

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Scrubbing steel with a brush of flame removes scale, rust, and surface moisture prior to painting. This is flame-priming, a LINDE development.

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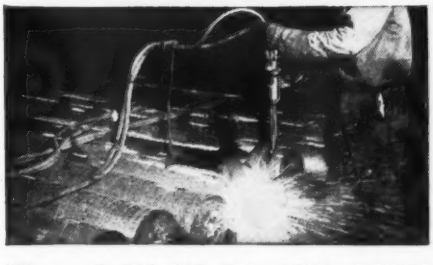

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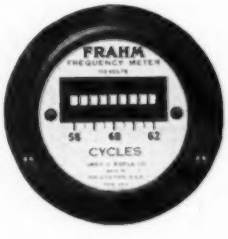

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mounted on the driving head and bored to receive the pump's shaft-top end. Impeller adjustment is made where the shaft's top end extends through the driver's hollow shaft. The driver also contains bearings to carry the total thrust load developed by the pump.

Motors, Fig. 1 and 2, right-angle gears, Fig. 3 and 6, and flat or V-belt assemblies are the commonest drivers —all of vertical hollow-shaft design. A flexible-coupling drive is used when a vertical solid-shaft prime mover is desirable.

When operation requires more than one driver a combination drive is used. For example, pumps are sometimes normally driven by an electric motor, in combination with a right-angle gear drive for emergency operation by gasoline or diesel engine.

Q 20—What types of impellers are used in vertical-turbine pumps?

A—Single-suction enclosed impellers, Fig. 4, in which the waterways are fully shrouded from suction to discharge, and semiopen impellers, Fig. 5, which have only a top shroud. Vertical clearance of the impellers in their bowls is obtained by an adjusting nut on the shaft's top extending through the pump drive.

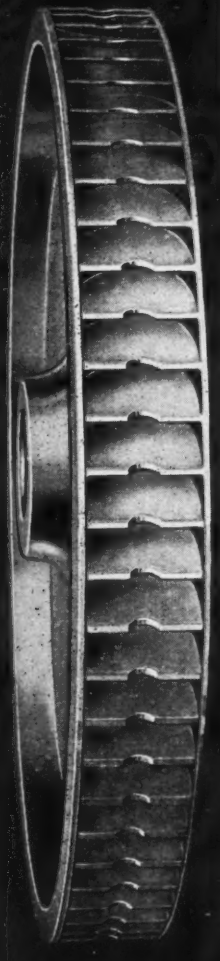
Semiopen impellers do not operate with close radial clearances such as wearing-ring clearance in an enclosed-impeller pump. They are generally considered to have some advantage when pumping sandy water, as the possibility of sand locking is reduced. Vertical clearance is important in a semiopen-impeller pump because maximum performance can be obtained only when the impellers are adjusted to operate as closely as possible to the bowl faces. A semiopen impeller develops a greater hydraulic thrust than an equivalent enclosed impeller because, without a lower shroud, there is a larger area that is hydraulically unbalanced.

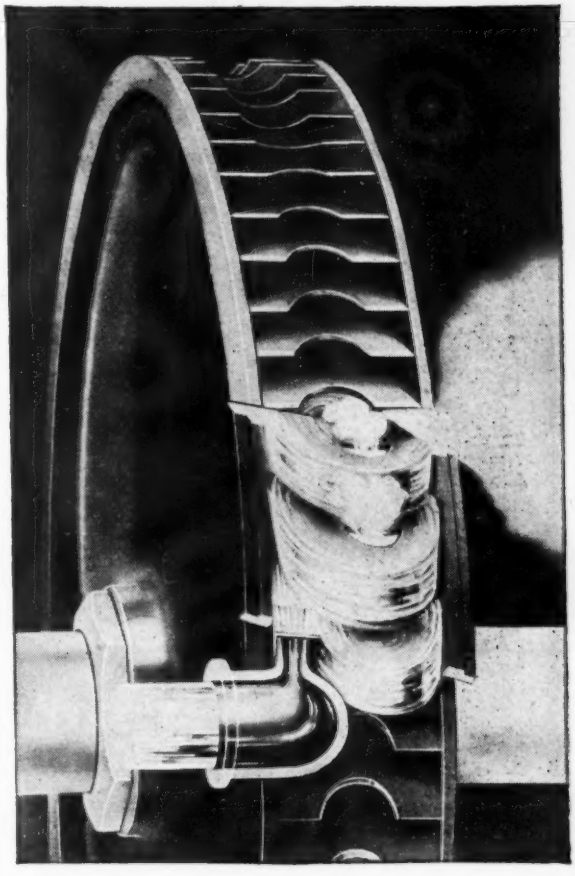
Q 21—What accessories are used with vertical-turbine pumps?

A—Suction strainers *E* of the conical type, Fig. 2, for wells or short-basket design for sump and pit service are commonly used to prevent the entrance of trash and large objects. Ten feet or more suction piping are often fitted to well pumps to allow for possible lowering of the pumping level of ground water.

Equipment can be furnished for determining the water level in a well. Pumps with open shafts are often equipped to lubricate the lineshaft bearings before starting. Follow manufacturer's instructions regarding prelubrication. Many types of manual or

TERRY





Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket in which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

NO PARTS TO LOOSEN OR WORK OUT

The rotor of the Terry Wheel Turbine is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to become loose or work out.

The power-producing action of the steam takes place on the solid curved backs of these buckets or pockets. Therefore close clearance is unnecessary and wear on the blades forming the pockets is of little consequence, as it does not materially affect horsepower or efficiency.

For detailed information about this effective construction and its advantages, write us on your business letterhead for a copy of Terry Turbine Bulletin S-116.

T-1172

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TERRY SQUARE, HARTFORD, CONN.

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EASILY INSTALLED

Their two bronze seats, ground to a true ball joint, mean longer service

Dart Unions are different. Their tightness is not derived from an ordinary "jammed" joint, but from two bronze seats ground to a *true ball joint*. They close drop-tight without excessive wrench pressure and open just as easily. What's more, they can be used over and over again in different locations. Both the body and nut are made of high-test, air refined malleable iron and are practically indestructible.

Let your supplier show you Dart's unique construction.

E. M. DART MFG. CO.
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DART
UNIONS

automatic-control equipment are available, depending upon the individual installation and the type of operation desired.

Q 22—What materials are used in vertical turbine-pump construction?

A—Table, p 108, shows typical materials of pumps that are generally considered standard. Bronzes, stainless steels and other special materials can be furnished as required by the characteristics of the liquid to be pumped.

Turbine Maintenance

(*Continued from page* 91)

ing of the throttle valve. Whenever tripping the emergency governor, either automatically or intentionally, the operator should make a record of the speed at which it functioned.

If turbines are shut down frequently test the emergency governors by overspeed once each month and operate the hand trip once a week. If the unit cannot be taken off the line once a week, the trip valve may be partly closed by means of the handwheel to make sure the valve stem moves freely.

Relief valves are provided at automatic extraction points and exhausts between the first shutoff valve and the turbine casing. At every inspection operators should test these relief valves, and determine by inspection, or disassembly if necessary, that the valve will open freely. Responsibility for proper functioning rests directly on the operator, but all concerned should make a concerted and persistent effort toward preventing loss of life as well as damage to valuable equipment.

Meters and Instruments

Gages, flowmeters and thermometers are nonproductive since they do not contribute to efficiency directly. Yet they are as essential to sustained efficiency of a power plant as micrometers are to the operation of a machine shop.

Some plants have so few instruments that operation efficiency can be judged only by the amount of fuel purchased. They are so inefficient that installation of a few instruments and adoption of a good maintenance plan would probably save enough fuel cost alone to pay the salaries of all its operators.

On the other hand, some industrial plants are well equipped with instruments, and have good operators and maintenance men. They operate at efficiencies approaching those of large central stations.

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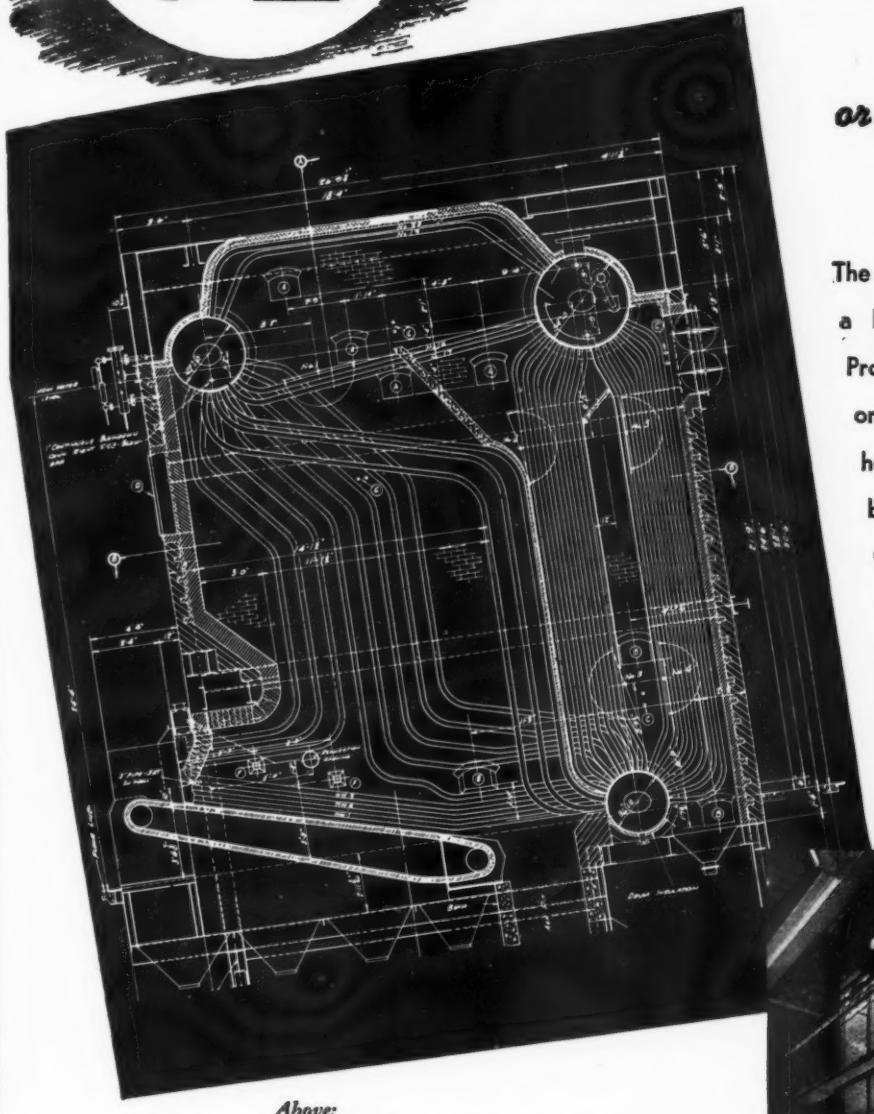
Steam Generating Units

for POWER *or* PROCESSING LOADS, *and* HEATING

The design provides large furnace volume and a high ratio of radiant heating surface. Proper combustion is assured with any fuel or method of firing. Superheaters, air preheaters, economizers, water walls, and soot blowers can be readily incorporated. Vogt Class VL Steam generating units are giving satisfactory service in Hotels, Sugar Refineries, Steel Mills, Furniture Factories, Distilleries, Oil Refineries, and related industries. A bulletin showing typical installations will be sent upon request.



Above:
This 90,000 lbs. steam per hour unit, designed for 475 lbs. pressure, serves the Mansfield Tire & Rubber Co., Mansfield, Ohio.

Right:
Two 515 H.P. units installed in Brown-Forman Distillers Corporation, Louisville, Ky. Plant.

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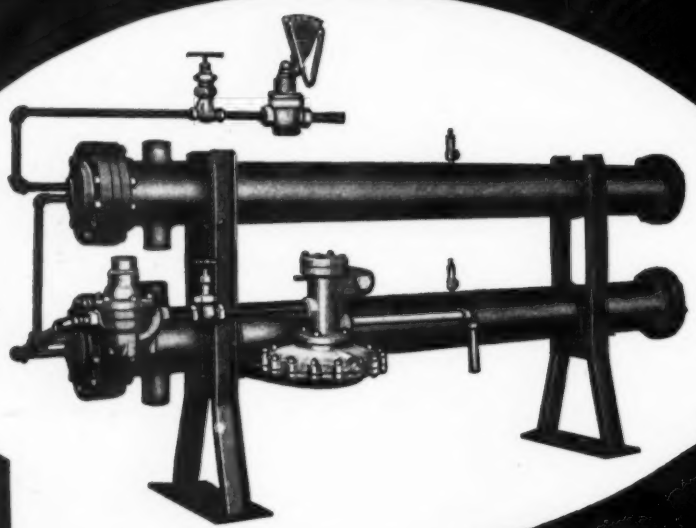
Branch Offices: New York, Philadelphia, Cleveland, Chicago, St. Louis, Dallas

$ $ $ Save WITH HENSZEY CONTINUOUS BLOWDOWN

SAVE EQUIPMENT—The Henszey Blowdown System prevents priming, foaming and carryover . . . and also prevents the formation of scale by simple chemical treatment of the feed water. Boilers last longer and tube burns are kept at a minimum. The resultant clean steam makes packings last longer — reduces wear on rods and cylinders —reduces turbine blade erosion — prevents sticking of reducing valves, traps, etc. — prevents superheater burnouts.

SAVE MANPOWER — The Henszey System is completely automatic. Boiler shut-downs and repairs are reduced to a minimum. No man hours lost unnecessarily replacing packings, repairing or replacing rods and cylinder rings, turbine nozzles, turbine blades, valves and other equipment along the line.

SAVE FUEL — The Henszey System offers complete, automatic blowdown without heat loss — a big fuel saving in itself. Then, too, boilers free from scale and sludge are more efficient — they require less fuel to produce the power load.



- Produces clean steam — no carry-over.
- Saves up to 95% of the heat loss of ordinary intermittent blowdown.
- Prevents Priming and Foaming.
- Prevents Scale (with simple chemical treatment).
- Automatically Controls Boiler Water Concentration.
- Indicates and Meters Blowdown.
- Practical for any size plant — large or small.

HENSZEY COMPANY
Dept. D1, Watertown, Wis.

HENSZEY

CONTINUOUS BLOWDOWN

Boiler Feed Regulators • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PREHEATERS

Flowmeters should be installed in all steam lines to turbines and all automatic extraction lines. It is neither necessary nor desirable to have flowmeters in lines to feedwater heaters. It is not enough to measure flow of steam from each boiler or the flow in the main steam header. There must be enough instruments to measure and record steam consumption of each turbine so that a decrease in efficiency or in capacity can immediately be detected.

Power-plant designers and manufacturers of turbines and other power-plant equipment have brought efficiencies up to a level where it is difficult and costly to gain another percent. Much more can be gained in most plants by giving maintenance the attention it deserves and by setting up repair schedules based on sound principles of economy.

REFERENCES

"Effect of Nozzle and Bucket Deposits on Turbine Capacity and Efficiency"; by B O Buckland; *General Electric Review*, Feb 1942.

"Indexes for Non-Condensing Turbine Overhaul"; by E E Harris; *Electrical World*, Oct 30, 1943.

"Maintenance Can Prevent Steam-Turbine Accidents"; by T W Howard; *Power Plant Engineering*, Oct 1942.

"Indexes That Point To Turbine Overhaul"; by E E Harris and G B Warren; *Electrical World*, Oct 31, 1942.

"Skillful Upkeep of Propulsion Turbines"; by H J Chase; *The Nautical Gazette*, Aug 1942.

Plant Problems

(*Continued from page* 116)

able and free from cracks.

Slip should not be tolerated, not only because of shortening belt life but because it is directly proportional to power loss. Thus a 1% slip represents a 1% power loss, or a 10% slip a 10% power loss, etc.

Montreal, Que. ARTHUR BELTON

Roughen Engine Flywheel

CALCULATIONS INDICATE that *IM's* belt is wide enough for the load of 250 kw. Therefore, the cause of slippage can be traced to lack of friction between the engine pulley and belt surface.

Friction between belt and pulley may be increased by tightening the belt. Clamps with spring balances between

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DEPEND on Youngstown's Buckeye Conduit for safety in electrical wiring. It is a standard-threaded, full-weight, rigid steel conduit of uniform, high quality. It provides the surest known protection against moisture, vapor, dust, crushing, vibration, and tampering by unauthorized persons.

Remember that this type of conduit is the only wiring system approved for hazardous locations by the National Electrical Code. So for Safety First, look for the underwriter's label bearing the name Youngstown on every length of conduit.

"Buckeye" is sold by leading electrical distributors in every industrial market.

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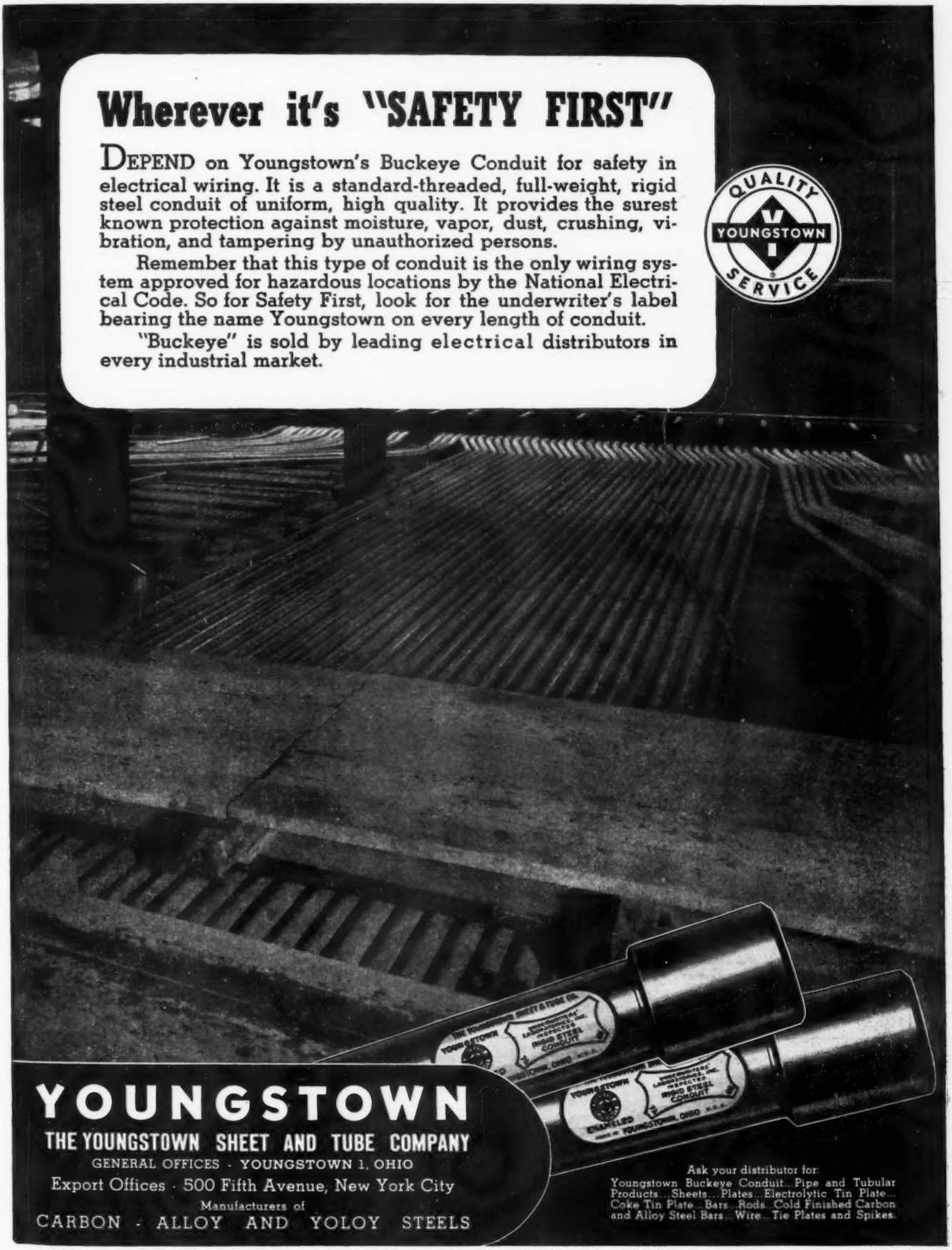

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NEW PLANT OR OLD...

Catawissa UNION and VALVE dependability means LOWER MAINTENANCE COSTS ... with an EXTRA margin of safety!

HOT FORGED STEEL AND STAINLESS STEEL UNIONS

STANDARD
1/8" TO 3"
Cold-Working Pressure up to 2,000 pounds.

DOUBLE EXTRA HEAVY
1/8" TO 2"
Cold-Working Pressure up to 6,000 pounds.

The Catawissa seat design gives you a perfect seal for every installation -- even when the pipe is not properly aligned -- with its 55-degree angle on the female end to a ball on the male end!

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ESPECIALLY ADAPTED FOR HIGH TEMPERATURE & HIGH PRESSURE SERVICE!
For boiler injection--engineered to outlast the boiler! Efficient, easily accessible!

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them should be used. The belt manufacturer should determine allowable tension.

If tightening fails to reduce belt slippage, the engine flywheel surface will have to be altered in some manner. This can be accomplished in two ways. First, the engine pulley can be covered with old leather belting. This covering must be securely fastened to the flywheel to prevent loosening. The method of fastening will depend upon the flywheel construction. The power transmitted with this type of arrangement is about 25% greater than the present maximum capacity.

The second method consists of "roughening" the engine flywheel surface enough to remove the polished metal. Extreme care should be exercised to prevent removal of too much surface metal. The surface should be such that it will not injure the belt. A portable grinder with a soft wheel is the best tool for the job. Grind to a dull finish.

New York City T G HICKS

Lag the Flywheel

BELT SLIP CAN BE eliminated by lagging the flywheel with either leather or 6-ply rubber belting. Friction depends upon pressure, but adhesion depends upon surface contact. The more the belt adheres to a pulley surface without straining, through too much tightening, the better the driving power.

A leather- or rubber-covered pulley produces more friction than a polished or rough iron surface. Good belt dressing increases belt adhesion. Friction of leather or rubber upon leather is four to five times greater than leather upon iron.

I would suggest a lagging material that is thin and pliable enough to be handled, and applied tight and smooth to the pulley face. Because of the width, it would be well to use two separate pieces for a total of 28 in. Although this calls for another row of bolts on the inside edge it is well worth it because the two separate pieces take care of the crown of the pulley much better than one 28-in. piece.

I suggest the following material: 2 pieces of double-ply leather or 6-ply rubber belting, 14 in. wide and long enough to reach around the pulley, plus enough to make a 45-deg. butt joint.

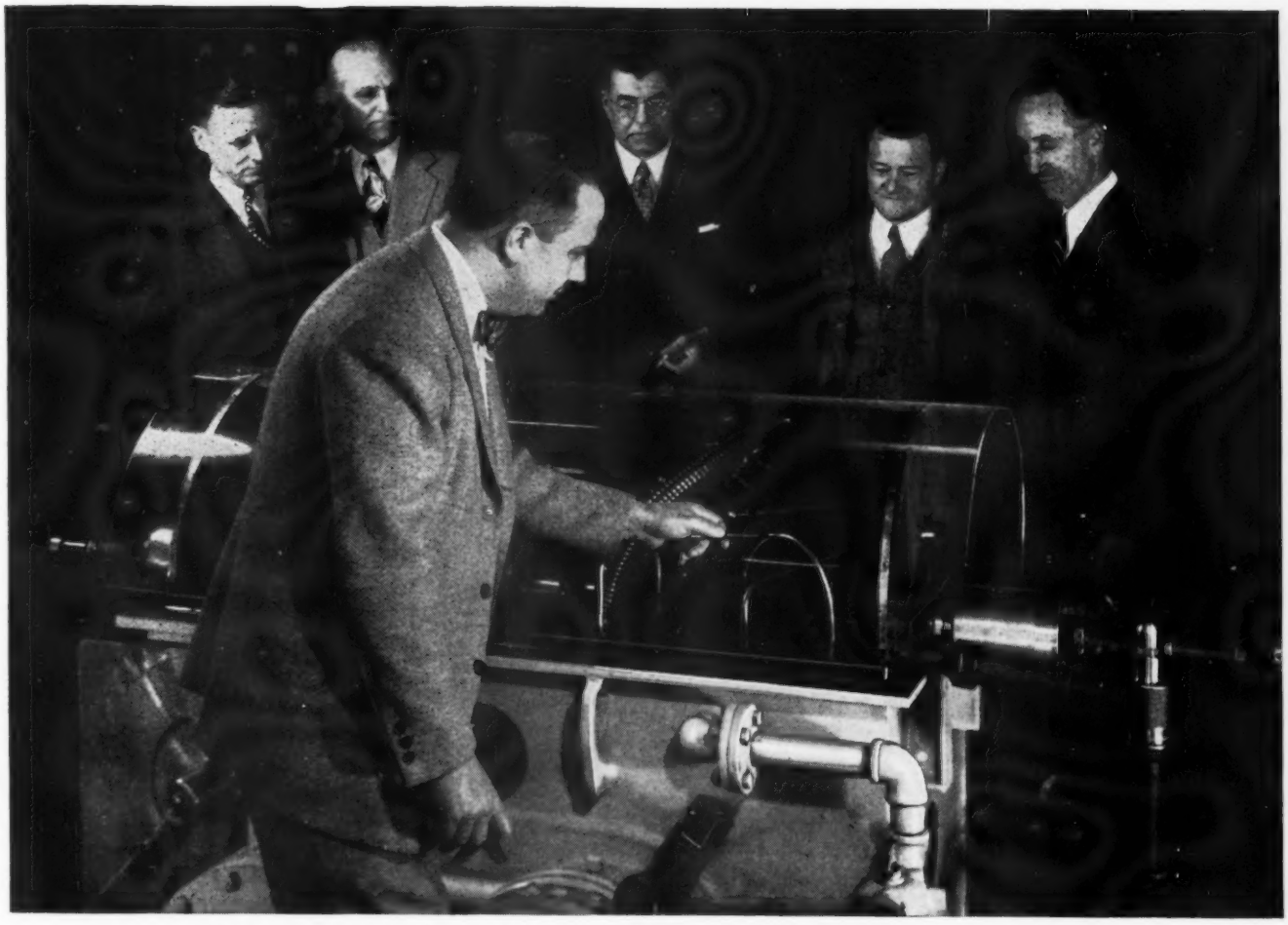
Anoka, Minn. H J GREINER

Clean and Re-oil Belt For Better Grip on Pulley

IM'S DRIVE SEEMS TO BE capable of handling the horsepower requirements. A

GÝROL FLUID DRIVE

FOR BOILER FEED PUMP CONTROL IS GETTING MORE AND MORE POPULAR!



Laboratory demonstration permits observation of rotating elements in an American Blower type VS class 6 Gýrol Fluid Drive for use with a 3600 RPM 2,000 H.P. Boiler Feed Pump.

Why?

Because Gýrol Fluid Drive saves power and is the proved means of providing the fine increments of speed adjustment required in the narrow speed range over which a boiler feed pump must operate.

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SKINNER "Universal Unaflow" Steam Engines are probably best known for their ability to generate electric power more economically than it can be purchased or produced by any other prime mover. They are serving in widely diversified industrial and institutional fields.

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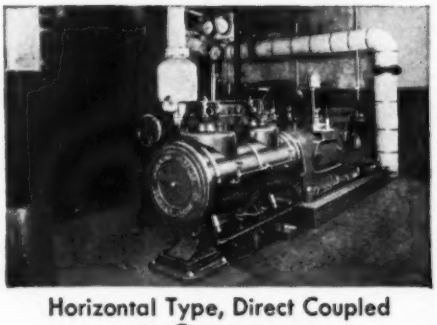
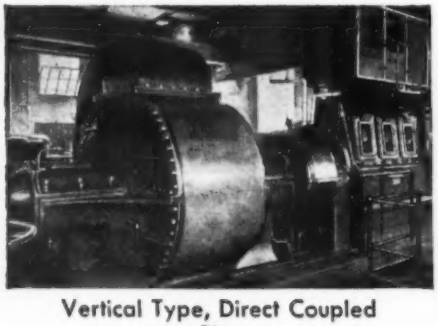
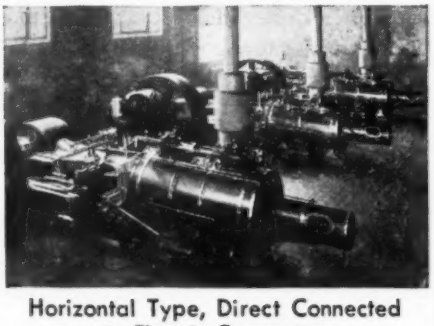


Horizontal Type, Direct Coupled to Compressor



Vertical Type, Direct Coupled to Blower



Horizontal Type, Direct Connected to Electric Generator

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For Over 75 Years, Doing One Thing Well—Building Steam Engines

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rider belt will not reduce slippage as it is impossible to keep both belts at equal tension, and consequently one belt carries more load. Dryness has caused the belt to lose its gripping qualities. Leather belts can be restored to their normal pliable state by first removing oil grease, irregular surfaces and shiny spots. This can be done by applying a solvent such as *Varsol* with a scrub brush. After the belt has thoroughly dried apply neat's-foot oil with a scrub brush, to the outside surface of the belt.

When belt is installed apply a small quantity of neat's-foot oil to the pulley faces before starting engine. The belt will become more pliable and develop greater grip on the pulleys as the oil works through the structure of the leather.

Amherstburg, Ont. G O ELLIOTT

Castor Oil Will Lubricate the Belt

CONTINUED USE at high temperatures has dried *IM's* belt out so the surface will not cling to the flywheel.

He should lubricate the belt each day with a fine trickle of pure castor oil until the leather becomes pliable. It will then hold to the pulley and last for years.

Do not use mineral oil of any kind.

Brandon, Man. W A WYBORN

Resurface Flywheel

IM HAS A CHOICE of several methods of eliminating belt slippage.

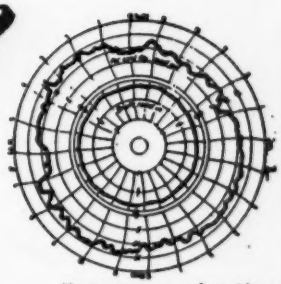
1. An over-riding belt, as mentioned, will reduce the slipping and should increase the life of the present belt.

2. Lagging the engine pulley with leather, canvas or rubber belting also eliminates slipping, but this is an expensive job. Lagging can be made secure by lacing along the edges with wire, or across the inside of the rim of the pulley. A rubber company may be able to supply a facing that can be vulcanized to the pulley in the field. This would make a neater, more effective job and should not cost too much.

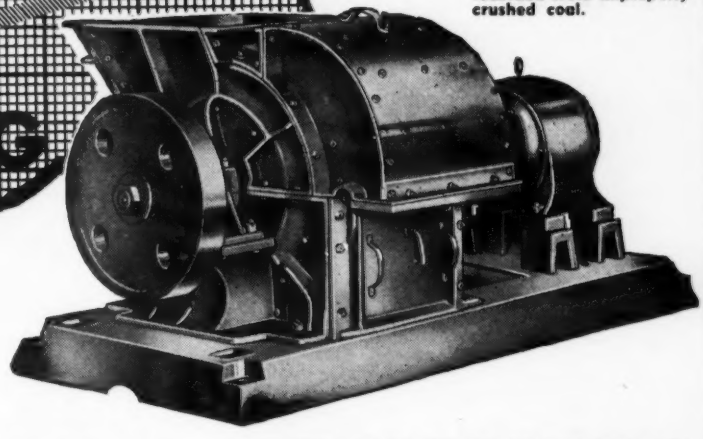
3. Before trying either of the above schemes, I suggest working over the face of the engine pulley. Use a coarse-grained flexible-disk portable grinder to remove the polished finish. Take care to keep the disk cutting across face of pulley.

4. Condition of the leather in the belt is of prime importance. A hard dry belt does not grip the pulley as well as a pliable belt does as it has a low coefficient of friction. A greasy belt also has a low coefficient of friction. The

INCREASE COMBUSTION EFFICIENCY through UNIFORM COAL SIZING



Uneven combustion recorded from improperly crushed coal.



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Stoking with coal uniformly sized by American Crushers increases firing efficiency (as recorded by CO_2 charts) from 2½ to 8% over coal prepared in conventional crushers. A series of impartial 24 hour operating tests run by an independent agency (name on request) has proven this, and the fact that the quality of the crushing is largely more important than the quality of the coal in efficiency of combustion.

Americans provide a compact, complete crushing operation in minimum headroom. No auxiliary crushing operations or equipment are necessary—no extra picking or standby-cleanout labor required.

American's exclusive manganese steel shredder rings rapidly and efficiently reduce ROM coal to stoker or pulverizer sizes with minimum fines and no oversize at a cost of less than 1¢ a ton.

American Type "S" Crushers, especially designed for power plants, are built in 9 different sizes, with capacities from 25 to 500 TPH.

AMERICAN Laboratory Mills

Custom-built to provide the required action for your specific laboratory or pilot plant operation. Available with shredder or rolling rings, regular or special type hammers to provide the exact type of reduction needed. Widely used to reduce grog for firebox liner replacement.

Send for bulletin: "Crushing Coal for Less than 1¢ a Ton"

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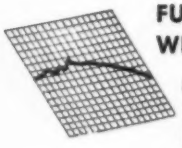
GOES TO WORK FOR YOU
IT WILL MAKE

A BIG DIFFERENCE

IN OPERATION
RESULTS

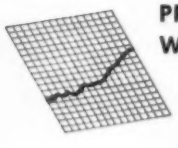


FUEL CONSUMPTION WILL BE REDUCED

Based on results in a majority of installations, a Stickle Differential Drainage and Boiler Return System—a self-contained closed pumping system—should reduce your fuel consumption about 15 per cent. The saving is seldom less, frequently greater, depending on conditions. Minimum results are predetermined and guaranteed.

BOILER CAPACITY WILL BE INCREASED

Boiler capacity will show increase in ratio to decrease of fuel consumption. Boiler load is reduced, and higher and more uniform operating pressure maintained. Condensate, returned to boilers, under pressure, at temperature only a few degrees below that of steam at operating pressure, is 85 per cent, or more, of boiler supply.



PRODUCTION VOLUME WILL BE GREATER

To higher and more uniform working pressure the Stickle System adds the two other requisites for effective performance of processing units: Dry steam and positive drainage. Processing units kept free of condensate and filled constantly with live dry steam operate consistently at, or near, their potential production capacities.

QUALITY OF PRODUCT WILL BE IMPROVED

Factors essential to high production volume are equally important for quality of output. Whether processing relates to reduction of food products, drying paper, producing textiles, or laundering operations, the tempo for production efficiency is also the tempo for desirable quality. Stickle Equipment helps to attain both.

ASK FOR BULLETINS

Executives who desire to learn more about the Stickle Differential Drainage and Boiler Return System are invited to request a copy of Bulletin No. 250. Those interested in a drainage problem only may secure helpful information from Bulletins Nos. 115, 315, 415 and 515. If problems of steam regulation are uppermost, Bulletins Nos. 235 and 435 will be helpful. For practical information on heating and purifying boiler feed water, ask for Bulletin No. 117. Bulletins mailed promptly on request.

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STICKLE DIFFERENTIAL AND BOILER RETURN SYSTEMS • STICKLE OPEN FLOAT STEAM TRAPS • STICKLE REGULATING AND REDUCING VALVES • STICKLE OPEN COIL FEED WATER HEATERS AND PURIFIERS • STICKLE OIL AND STEAM SEPARATORS STICKLE TEMPERATURE CONTROLLERS AND OTHER SPECIALTIES

field representative of a reliable leather manufacturer should be asked to inspect the belt.

5. The load of 275 kw appears to be somewhat high for a 3-ply belt, 28 inches wide. This amounts to about 13 hp per in. of belt. An over-riding belt would reduce the load per in. of belt and should reduce maintenance cost.

Piney River, Va. I A BUTCHER

Clean and Wax the Belt

STICKY BELT DRESSING is not the proper solution for slippage of a heavy leather belt. Neither is mere surface slickness of a driving or driven pulley a fundamental cause of slipping. Common belt dressing eventually destroys the true gripping surface, while a smoothly polished pulley contributes greatly to long belt life.

If a belt has proper tension, slippage under load is caused by its internal properties or the condition of its gripping surface. Surface cracking, caking of old belt dressing on the surface or running the belt with the flesh side against the pulleys are examples of surface conditions that cause slippage. Loss of pliability, oil or grease impregnation and a too-thick belt for small pulleys are examples of internal conditions that may cause slippage even if gripping surface is ideal.

A rider belt or rope is helpful only if slippage of the main belt is caused by stiffness or too-heavy ply. The benefit of a rider is small if slippage is caused by poor gripping surface. If a once-suitable belt begins to slip excessively, a better method is to recondition it.

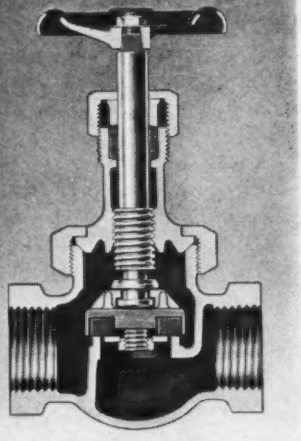
To restore a slipping belt to better gripping condition, both internally and externally, turn it over on its pulleys and wash both sides with soapy water and a scrub brush. Scrape off any caked substance with a case knife or other dull instrument. Work the suds well into the leather, then rinse thoroughly with warm water.

While the belt is still damp, but not too wet, start it slowly under light tension. With the rounded end of a piece of hardwood, such as a baseball bat, press the belt firmly against the larger pulley. Rest the piece of wood on a sawhorse. As the belt moves between the wood and pulley, the surface fibers are smoothed and aligned. Any excess soap not removed by the rinse water is pressed out. This operation helps dry the belt.

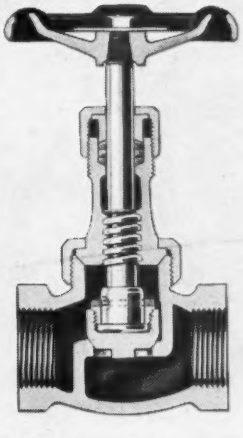
When the belt is completely dry, increase its speed and tension and exert greater pressure against it with the wooden instrument. Avoid pressing against any lacings as they pass. When the leather begins to show a glossy sur-

BRONZE

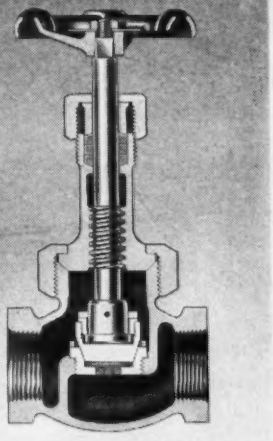
GLOBE, ANGLE, GATE and CHECK VALVES— EACH ONE PROVED DEPENDABLE FOR LOW-COST FLOW CONTROL!



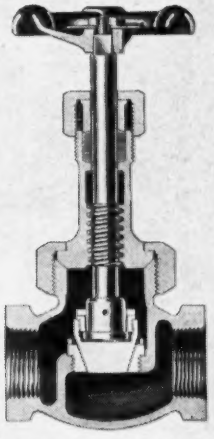
Union Bonnet Globe (or angle). With renewable, interchangeable discs for general services.



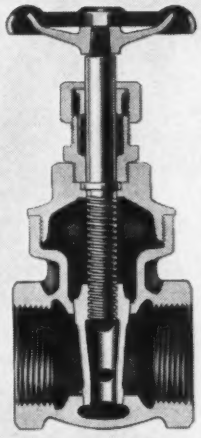
Union Bonnet Globe (or angle). Discs may be reground without removing valve from line. For occasional throttling.



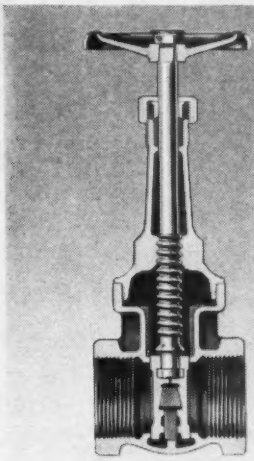
Union Bonnet Globe (or angle). Semi-plug type for frequent throttling service. Renewable copper nickel alloy disc and seat ring.



Union Bonnet Globe (or angle). Full plug type for severe throttling service. Renewable copper nickel alloy disc and seat ring.

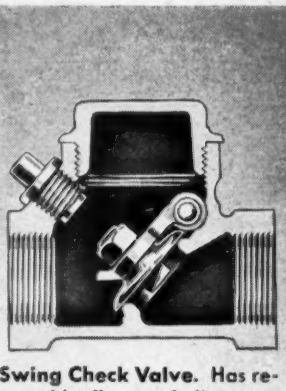


Stationary Stem Gate. Solid wedge renewable. Wedge can be reversed if one side becomes worn.



Rising Stem Gate with double disc. Disc easily assembled or taken apart—yet cannot work out of place.

SHOWN HERE are some of the numbers in the R-P&C line of high quality bronze valves. R-P&C also make iron and steel globe, angle, gate and check valves —iron cocks and Lubrotite gate valves—Bar Stock valves of bronze, carbon steel and alloy steels—cast steel fittings. Get in touch with your Reading-Pratt & Cady Distributor.



Swing Check Valve. Has renewable disc, regrinding seat. Disc free to rotate, thus distributes wear uniformly.

ACCO

Reading, Pa. • Atlanta • Baltimore • Boston • Chicago • Denver • Detroit • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • Portland, Ore. • San Francisco • Bridgeport, Conn.

READING-PRATT & CADY DIVISION
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face, apply a good wax, such as Shinola. Work this into the belt, applying moderate pressure. Two or three boxes is enough for a large belt.

As soon as the surface has a suitable polish, stop the belt, clean the pulleys thoroughly, then turn the polished side of the belt against them. This method of reconditioning will stretch the belt, and adjustments must be made accordingly.

Marissa, Ill. GEORGE HOLMAN

Diesel Operation

(*Continued from page* 87)

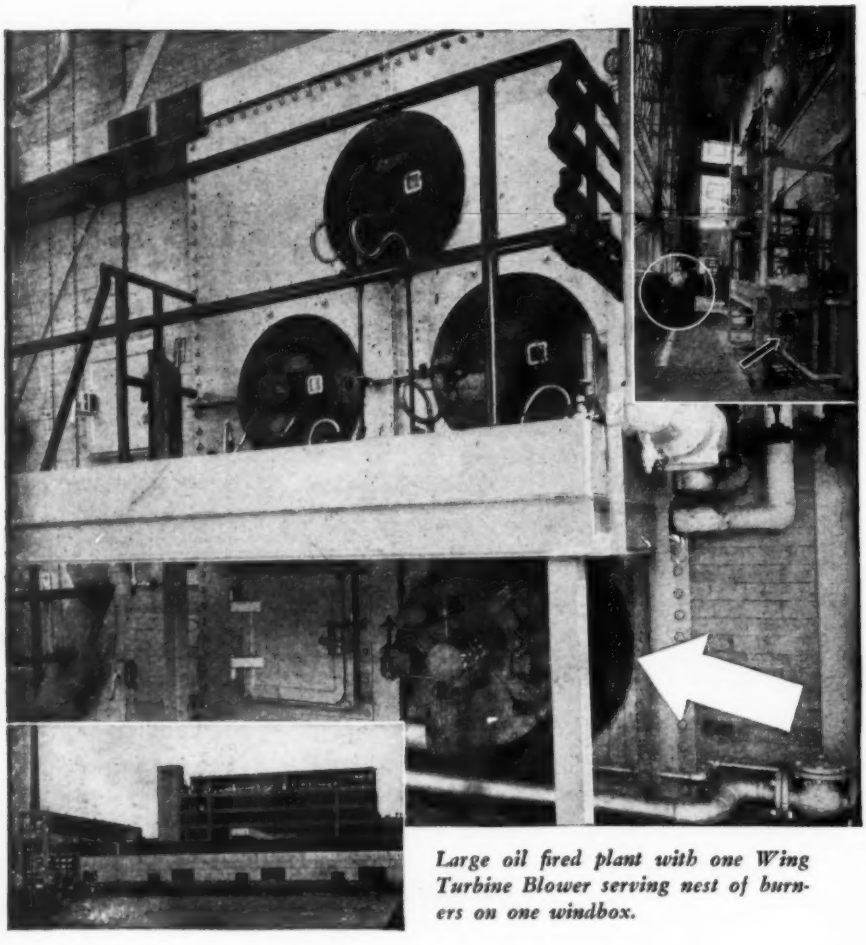
practicable, they should be kept out of highly loaded areas. The grooves should be streamlined by breaking or radiusing the sharp corners.

Some grooving serves to carry oil to other bearings (see illustration). Conventional main bearings form an example. While oil grooving is discouraged in bearing sections that are highly loaded, it is often desirable to incorporate some at localities where loading is low, to aid in proper distribution of lubricant. This is the purpose of the so-called distributing grooves, usually incorporated in relatively long as well as large bearings.

Flanged Bearing. Flanged bearings for large diesels are of two classes: those in which flanges merely serve to center the relatively rotating mass, such as a connecting rod, and those in which flanges actually take a steady or intermittent thrust and whose purpose is to keep the parts in their respective positions under such loads.

Most large diesels have used and are using flanged bearings of the first type in connecting rods. These flanges usually do not need grooving but depend on bearing-end oil leakage to provide what little lubrication they need. True-thrust flanged bearings, however, should have grooves on the flange faces to help distribute oil over the flanges for film formation. Again, it proves desirable to limit amount of grooving so as not to jeopardize building up oil-film pressure. The simplest and commonest groove for flanges is the so-called "thumbnail" type illustrated. Relief in the form of a shallow taper is provided at the junction of the flange with the parting face to eliminate possibility of a sharp flange corner scraping oil off this thrust surface.

Prime importance attaches to establishing initial oil clearances for diesel bearings. General rules are extremely difficult to set up since some lining ma-



Large oil fired plant with one Wing Turbine Blower serving nest of burners on one windbox.

Wing Turbine Blowers Save:

POWER COSTS—because they can be installed on windboxes thereby eliminating duct losses requiring higher initial driving power.

ENGINEERING LAY-OUT TIME AND EXPENSE—because there are no ducts to design and find space for with their cumbersomeness and expense.

MAINTENANCE—because of their utter simplicity. An occasional shot of lubricant to the two ball bearings plus a very infrequent take-up on packing glands is all that is required of routine handling. There is no more rugged machine in any power plant than a Wing Blower.

Write for Bulletin SW-1

L. J. Wing Mfg. Co. **50 Seventh Ave.,** **New York 11, N. Y.**

Factories in Newark, N. J. and Montreal, Canada

TURBINE BLOWERS • TURBINES • • FANS • MOTOR DRIVEN BLOWERS
REVOLVING UNIT HEATERS • UTILITY HEATERS • FIXED DISCHARGE UNIT HEATERS
DUCT FANS • DRAFT INDUCERS • HEATER SECTIONS • SHIP VENTILATORS • FOG ELIMINATORS

The code calls for:

. . . two gage glasses on pressures over 400 psi

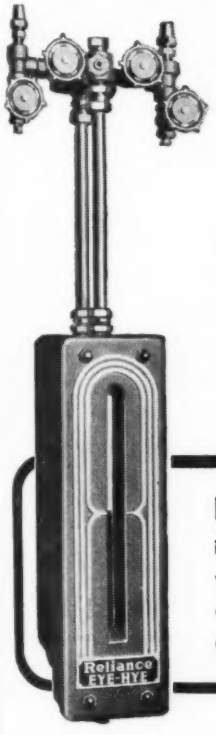
Reliance *TWIN GAGE* Water Column Assemblies

provide a simple and convenient means of complying with the code

● You adhere to code requirements for maximum safety and efficiency in operating your power plant. It's up to you to select equipment that follows code procedure and gives you *the most satisfactory service.*

Probably the best practice in applying the rule for two gages on boilers operating at over 400 psi is by means of a *water column assembly.* This provides flexibility of placement, ease of providing mechanical support, greater stability of water level indication, provision of high and low alarm signal if desired (up to 900 psi), and over-all convenience and safety of operation.

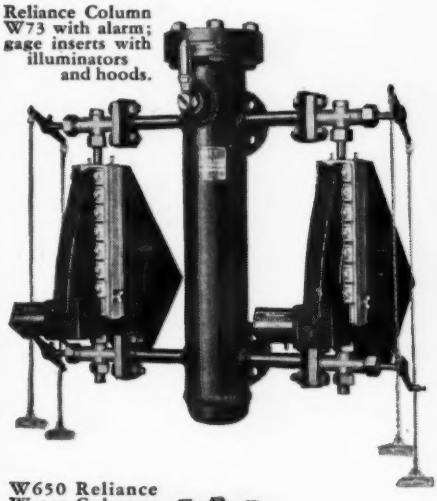
"Single water column with two gages" is the most popular selection, according to Reliance experience. Principal water column manufacturer for 63 years, Reliance practice is to give you a wide margin of safety in rugged construction, fully approved welding procedure . . . and expertly custom-made equipment. Write for information on twin gage water columns.



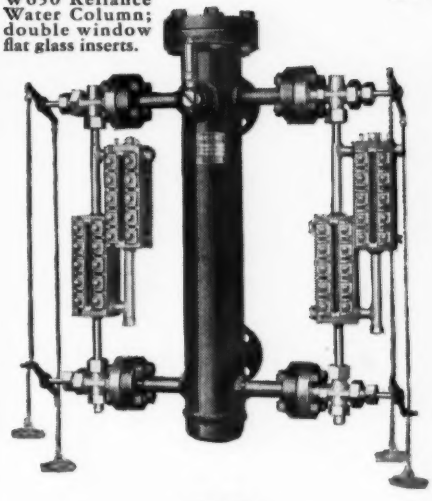
EYE-HYE Remote Reading Gage

is a "duplicate" gage that gives you accurate water level reading at convenient stations—on wall or instrument panel. Models for any pressure. More than 7000 in service.

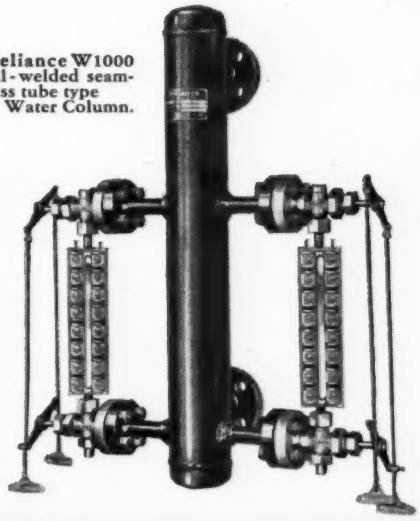
Reliance Column W73 with alarm; gage inserts with illuminators and hoods.



W650 Reliance Water Column; double window flat glass inserts.



Reliance W1000 all-welded seamless tube type Water Column.

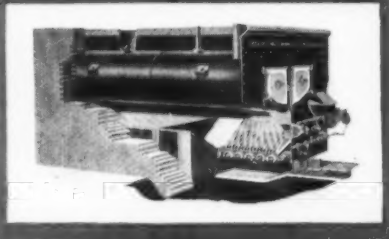


BOILER SAFETY DEVICES since 1884

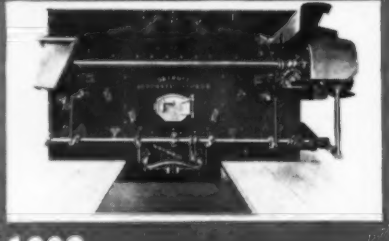
Reliance

THE RELIANCE GAUGE COLUMN CO. • 5902 CARNEGIE AVENUE • CLEVELAND 3, OHIO

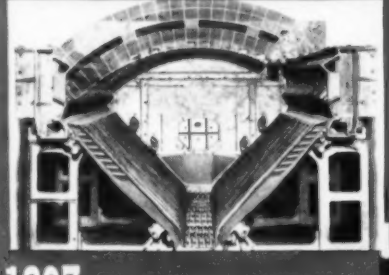
PROGRESS THROUGH THE YEARS DETROIT STOKERS *past...*



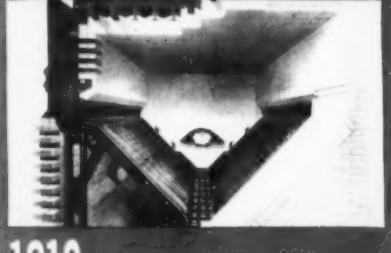
1898 First Detroit Automatic Stoker, Screw Feed.



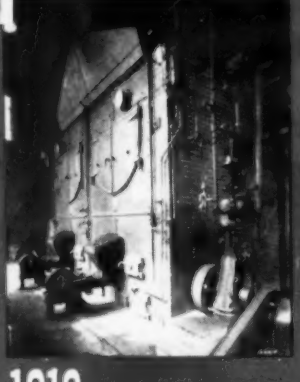
1902 Improved Detroit Stoker, V Type Screw Feed.



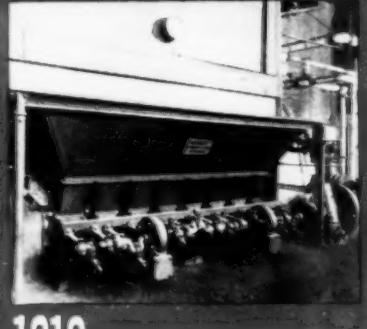
1907 First Detroit V Type Stoker, Reciprocating Feed.



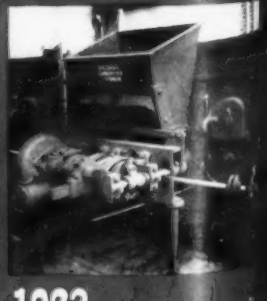
1910 Detroit V Type Stoker with Detroit flat arch.



1919 First Detroit Underfeed Stokers.



1919 First Detroit Multiple Retort Stoker.



1923 First Detroit Double Retort Stoker.

HALF A CENTURY

50 YEARS OF LEADERSHIP

Building Stokers Exclusively

On this our Fiftieth Anniversary, we express our appreciation of the confidence placed in us by many Engineers, Architects and satisfied users, for their favorable consideration of our Stokers. Without their cooperation and approval, the present standing of our Company in the Industry could never have been achieved.

To them we say:

"Thank you, and we trust our efforts in the future will warrant your continued patronage."

DETROIT STOKER COMPANY

MAIN OFFICE AND WORKS—MONROE, MICHIGAN

SALES AND ENGINEERING OFFICE,
GENERAL MOTORS BUILDING, DETROIT, MICHIGAN

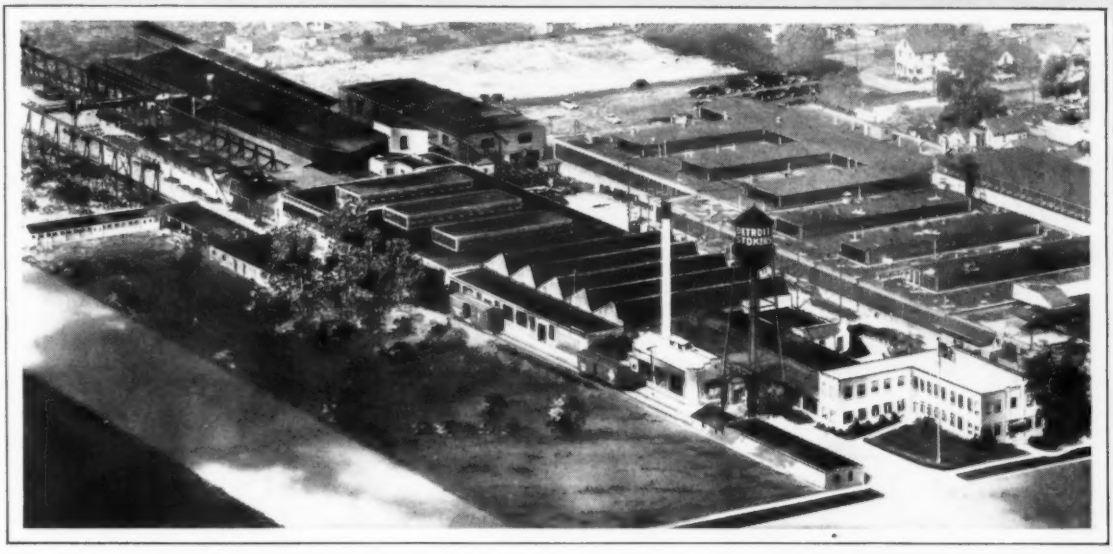
Offices in all Principal Cities

1898—1902

First Detroit Stoker Plant, located in Detroit.

1902—1922

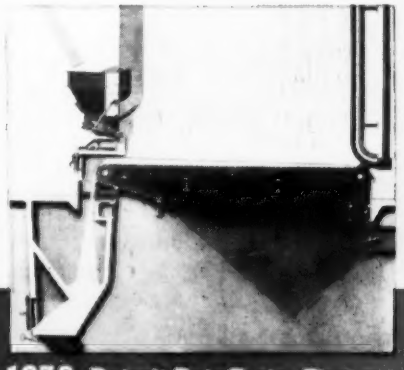
Second Detroit Stoker Plant, located in Detroit.



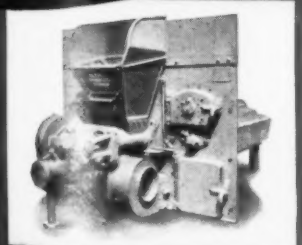
1948 Present Detroit Stoker Plant—Monroe, Michigan. Production of Detroit Stokers in 1948 has reached an all time high due to universal demand.

Fifty Years of Experience in combustion engineering and building stokers exclusively.

...and present



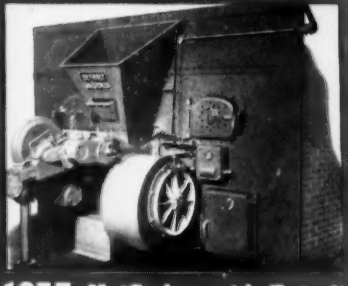
1938 Detroit RotoGrate. First continuous ash discharge spreader stoker with forward moving grate.



1925 First Detroit UniStoker (motor and fan direct connected).

1928 First Detroit Junior LoStoker.

1932 First Detroit (spreader) RotoStoker—Still in operation.



1937 UniStoker with Detroit Adjustable Coal Feed Control.

Swartwout announces these
New Precision Controls

for safe, accurate regulation of DIFFERENTIAL PRESSURES

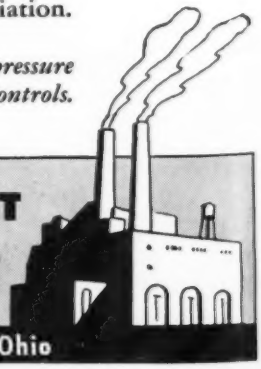
Write today for New Bulletin S-17

● As you know, there are many excess and differential pressure situations which can be exceedingly troublesome if they are not adequately controlled. The new Swartwout Differential Pressure Master Controls are designed to supply dependable regulation for complicated pump control applications, fixed pressure drop over orifices — and numerous other power and process applications. Also ideally suited to accurately control liquid levels in pressure vessels up to 1500 psi.

These Swartwout Master Controls operate on the principle of balance of forces, involving very little actual motion of parts. They are constructed without stuffing boxes, packing or seals. The mechanism is extremely simple and rugged; setting is accomplished by only two adjustments. The controls supply immediate, smooth-acting response to the slightest variation.

• • •

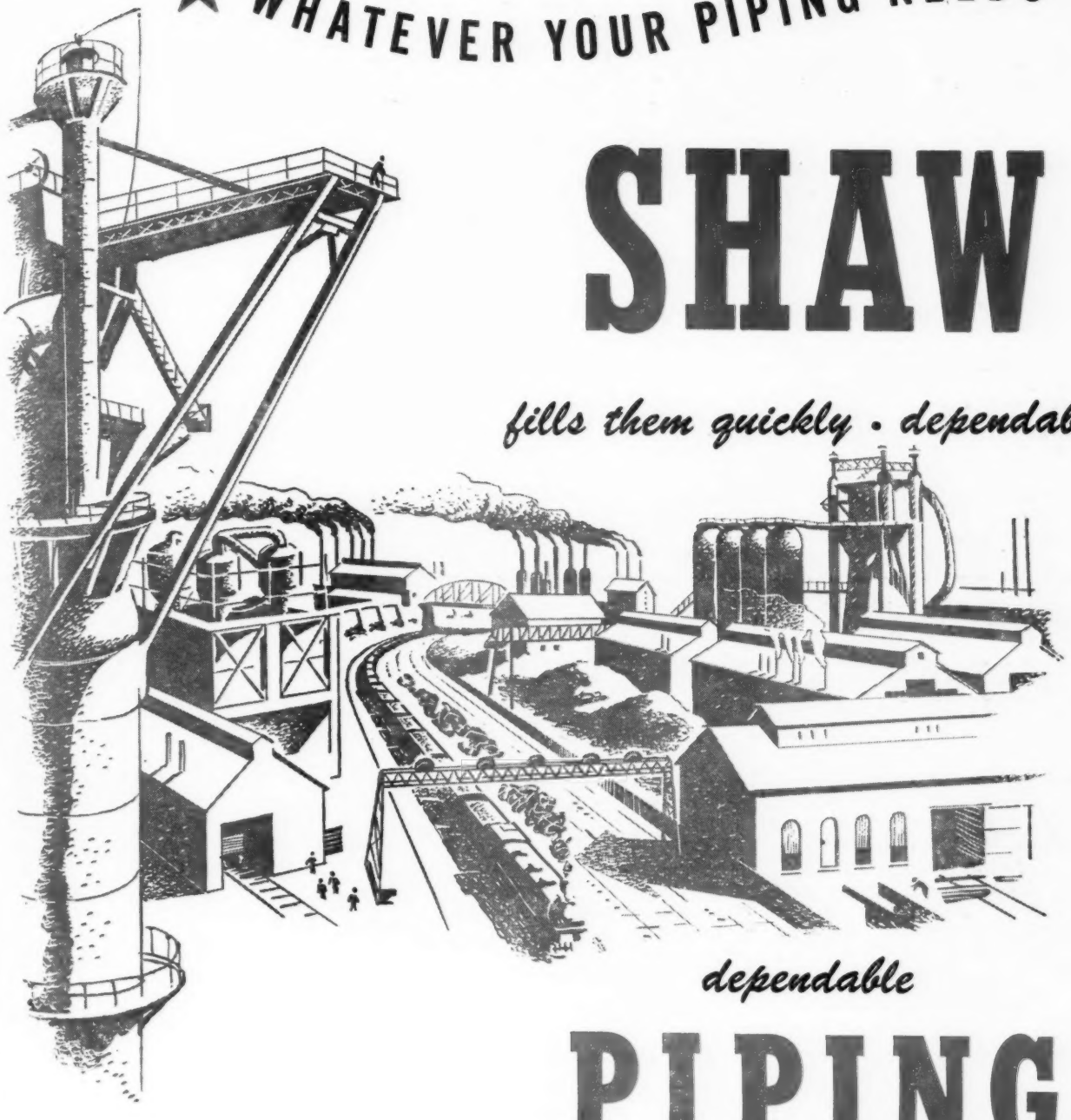
Improve your handling of differential pressure situations with Swartwout Master Controls.



Swartwout **POWER PLANT EQUIPMENT**

THE SWARTWOUT COMPANY • 18511 Euclid Ave., Cleveland 12, Ohio

★ WHATEVER YOUR PIPING NEEDS



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fills them quickly • dependably

dependable

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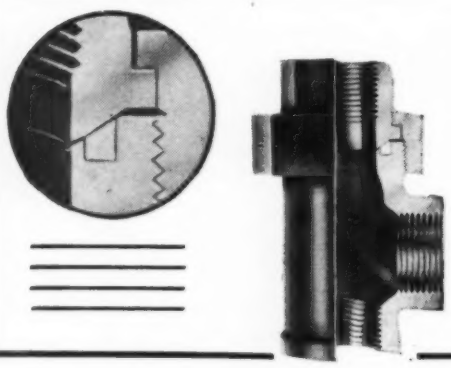

JEFFERSON
Specialty UNIONS
feature the RECESSED BRASS SEAT

for permanent tightness without jamming

All Jefferson Specialty Unions feature the Recessed Brass *spherically ground* Seat which assures a leakproof union rather than a jam joint. Furthermore, this design provides a brass to iron joint with the seat so recessed as to be fully protected from pipe ends should pipe be screwed in too far.

The Jefferson Specialty Union illustrated . . . A Union Tee . . . is recommended for use where a union is required near a tee. The application of a union of this type will simplify piping installation and result in fewer pipe joints.

The Jefferson line of Specialty Unions is complete as to types. Full details can be had from your nearest distributor . . . or write us direct.

Jefferson Union Tee, All Female, with union on the run.

JEFFERSON UNION CO.
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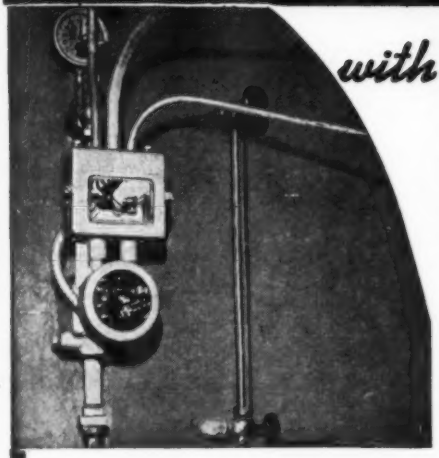
LEXINGTON 73, MASS. **LOCKPORT, N. Y.**

No Waterlogging or Air Binding
in HYDRO-PNEUMATIC TANKS EQUIPPED



with **DUOTROL**

The DUOTROL maintains high water level at a fixed point and correctly balances air pressure after each pumping operation. It provides a maximum volume of water with a minimum of pump operation, saving power and reducing wear. Easy to install, stable adjustments.

The DUOTROL shown is on a tank where water at 50° F. is pumped from a 600 ft. well for summer cooling of a complete shopping center. The pressure range is from 30 to 70 lbs. Ask for Bulletin D-6.

"AUTOMATIC" also makes pressure and float operated pump controls: multi-circuit sequence type, multi-circuit program type, float switches, automatic alternators, and many special controls built to specifications.

AUTOMATIC CONTROL Company
1009 UNIVERSITY AVE., ST. PAUL 4, MINN.

AUTOMATIC CONTROLS are used by all leading pump manufacturers. When ordering new pumps, specify controls by AUTOMATIC CONTROL CO.

terials require more clearance than others, and normal running speeds vary from engine to engine. Based on average engine usages, the chart on p 87 can be used as a rough guide to minimum desired oil clearance for five lining materials.

The bearing manufacturer usually establishes the minimum permissible diametral clearance for the application, based on maximum shaft tolerance, maximum wall thickness and minimum bearing-housing bore. The actual possible maximum oil clearance thus depends on how closely tolerances of the respective parts can be held.

E M Dart Mfg Co, Providence, R. I., has adopted a new firm price policy. On and after Oct 1, 1947, all prices quoted on Dart products are on a firm price basis, subject to acceptance within 15 days from date of quotation. All products shipped on orders dated Oct 1, 1947, and thereafter, are billed at prices in effect on date order is accepted, or at prices prevailing at time of shipment, whichever is lower.

Buffalo council legislation committee voted to receive and file application of Buffalo Steam Service Corp for consent to install steam pipes underground in downtown Buffalo for heating and power purposes. The application, which has been before the committee a year, drew opposition from Buffalo Fuel Merchants Association, International Brotherhood of Firemen and Oilers, International Brotherhood of Operating Engineers, and others at a lengthy hearing before the committee last fall and early this year.

POWER'S History

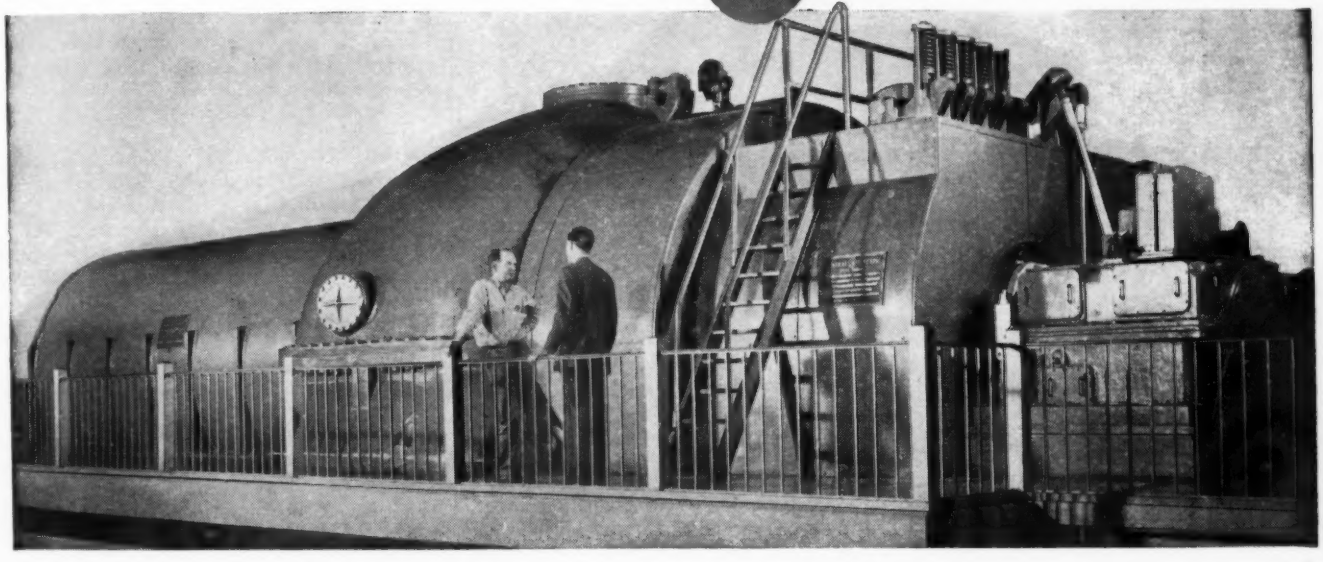
POWER was founded in 1884 by E P Harris and H M Swetland. With it was incorporated *Steam*, which had been started by N Hawkins in Chicago two years earlier.

In 1903 POWER purchased and absorbed *Science and Industry*, which was a consolidation of a number of periodicals, namely, *Home Study Magazine, Home Study for Machinists, Mechanic's Magazine, Home Study for Building Trades, Building Trade's Magazine, Home Study for Electrical Workers* and *Steam Electric Magazine.*

In 1908 POWER absorbed *The Engineer's Review*, of Cleveland, and *The Engineer*, of Chicago, the latter being a consolidation of *The Safety Valve, Lord's Power and Machinery Magazine, The Stationary Engineer, Steam Engineering* and *The Mechanical Engineer.* When *The Engineer* was purchased, the name of the combined magazine was *Power and the Engineer.* The title was condensed to POWER in 1911. All rights to the preceding titles reserved.

The first consideration in turbine oil selection

does it provide full protection for my big investment?



GULFCREST OIL WCR provides safe, sure, efficient lubrication—lasts indefinitely!

A steam turbine represents one of the largest expenditures that can be made for a single unit of industrial equipment. Compared to that investment, the finest oil you can buy to help protect it is ridiculously cheap.

For safe, sure, efficient lubrication, scores of leading turbine operators specify Gulfcrest, the world's finest turbine oil. The important reason: After conventional refining, Gulfcrest Oil is superrefined by the Alchlor Process.

More than 15 per cent of the oil is discarded by the Alchlor Process—this 15 per cent contains the hydrocarbons most likely to oxidize and form sludge, emulsifiers, and harmful acids.

That's why Gulfcrest is incomparably pure—why it gives outstanding performance, and lasts indefinitely. Send the coupon at right for booklet which gives you the complete facts on this superior turbine oil.

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JOIN THE TREND — Experience with both Proves Open Bucket Best

Experience of steam trap users has proved that, for smoother operation, open bucket type traps are superior for all-round service.

New "Cub-Jr"—ideal wherever a small, reliable trap is required

For the many and varied applications where a small, efficient trap is desirable, the new "Cub Jr." is the ideal, all-purpose, double-duty trap to use for the prevention of production troubles caused by water-logged equipment. Its use shortens warm-up time on steam-using processes. It will handle up to 2000 pounds of condensate per hour on continuous discharge. Overall dimensions of trap are 3¼" x 5½".

New "Cub-Jr" Open Bucket Type Steam Trap Pressures to 125 psi

All "Cub" Traps discharge both air and condensate

It is not enough, that a WRIGHT-AUSTIN "CUB" steam trap shall efficiently remove air and condensate from service lines—it must be qualified to live up to the expectations of every user. That it does this is proved by the large volume of repeat orders.

These are the qualities you will find in "Cub" open bucket type steam traps—qualities which contribute to world-wide acceptance and use:

Double Rating on continuous discharge
No Waste of Steam
Stainless Steel valves, seats and buckets
Easy to Install
Water Seal entirely within trap

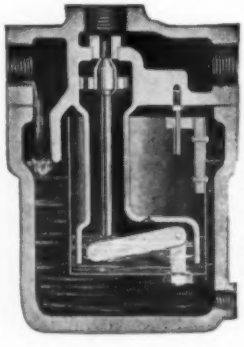
All sizes of "Cub" Steam Traps except "Cub-Jr." are suitable for pressures up to 250 psi. Other types of Airxpel Steam Traps available for pressures up to 700 psi.

You'll find complete details in Circular 259-A.

Send for a copy today

No. 51 "Cub" Airxpel Open Bucket type Steam Trap

No. 52 "Cub" Airxpel Open Bucket type Steam Trap



Inside the "Cub"

This view shows the inside water seal which prevents waste of steam. It shows also straight through pipe connections and accessibility of valve and seats.

Send for Circular 259-A

WRIGHT-AUSTIN COMPANY
316 West Woodbridge St. Detroit 26, Mich.

WA Standard with STEAM USERS SINCE '94

WRIGHT-AUSTIN

SERVING INDUSTRY FOR MORE THAN 50 YEARS

APPOINTMENTS

Appointments to a newly created position of manager in charge of both sales and engineering have been made for all sections of **Allis-Chalmers** electrical dept. H A Bartling is now manager of new electronics section, which incorporates sales and engineering functions of former rectifier section and electronics sales and engineering groups, which were previously part of control section. L W Long is now manager of substation section, formerly known as mixed apparatus section. R M Casper is named manager of motor and generator section. Carl W Bernhard has been made assistant to Casper. G W Clothier has been appointed manager of transformer section. E E Ellis has been named engineer-in-charge of sales, motor and generator section of electrical dept.

A complete line of chemicals for industrial water conditioning and fuel-oil treatment is now available in Mexico from **Bird-Archer Co** through their technical representatives, Calderas Y Accessorios, Amsterdam 291, Mexico, D. F.

Leslie Co announces appointment of following agents to handle industrial sales and service: (1) Seth A Good & Co, Dallas, Tex., covering northeastern Tex., (2) Equipment Sales Corp, Kingsport, Tenn., covering eastern Tenn., (3) Fair Enterprises, Honolulu, Hawaii, covering territory of Hawaii.

Frank T Lewis has been named assistant manager of **General Electric's** Schenectady works. Three staff appointments have been announced by J W Belanger, newly named manager of turbine and gear divisions of apparatus dept. The appointments are: (1) C S Coggeshell, manager of sales, (2) W E Saupe, manager Schenectady turbine manufacturing div, (3) W L Young, manager, Lynn turbine and gear manufacturing div.

John M West has been appointed director of public relations div of **Foster Wheeler Corp,** New York City, in charge of advertising, publicity, literature and house organs.

Foote Bros Gear and Machine Corp announces advancement of R B Moir to assistant vice-president in charge of engineering and product development of industrial gear div. B H Quackenbush now assumes full responsibility of sales manager of this div.

Francis A Paquin has been made chief tool engineer of **Sier-Bath Gear & Pump Co,** North Bergen, N. J.

Edmund Greene has been appointed sales promotion and advertising manager of Merrimac div of **Monsanto Chemical Co.** Merrimac div has its headquarters in Everett with sales offices in Boston.

Kellen Wiles has been appointed executive assistant to G C Derry, general manager of Sturtevant div of **Westinghouse Electric Corp.** at Hyde Park, Mass. Alexander

(*Continued on page* 186)

DOWELL

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

How much POWER

—can Dowell chemical cleaning restore for you?

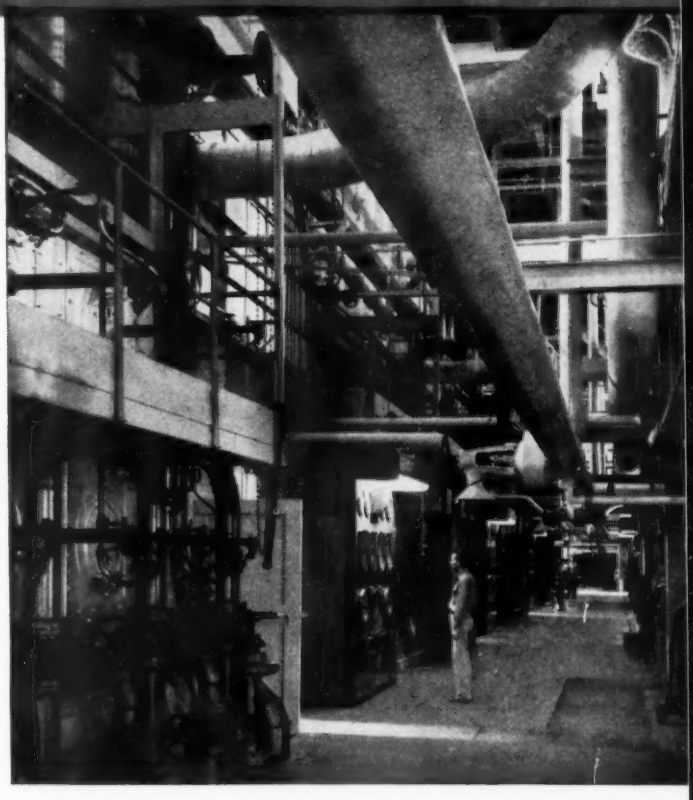


Figure it in dollars and cents: How much power are you losing due to accumulations of scale and sludge in boilers, condensers and other heat-exchange equipment? How much is it costing you for the extra fuel required to overcome the reduced efficiency imposed on your plant by *insulating deposits?*

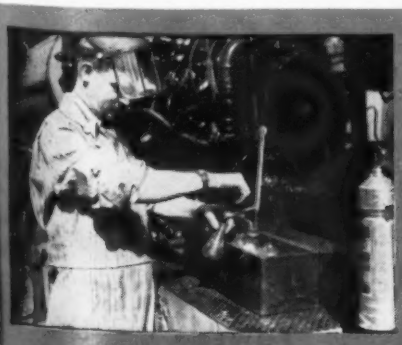
Take a good look at your designed operating efficiency—and compare it with the *actual output* you are securing. Then call the nearest Dowell office for the facts and figures on *chemical* scale removal service.

Leading plants everywhere rely upon Dowell service—including some of the largest boiler installations in the nation. They tried Dowell service and found it rapid, safe and economical. They've seen Dowell engineers fill plant equipment with liquid solvents designed to dissolve and disintegrate scale and sludge—and they've seen the *results.* You'll make no mistake to follow their example—get the facts.

DOWELL INCORPORATED • TULSA 3, OKLAHOMA

New York, Boston, Philadelphia, Wilmington, Baltimore, Pittsburgh, Buffalo, Cleveland, Cincinnati, Detroit, Chicago, St. Louis, Kansas City, Wichita, Oklahoma City, Houston, Fort Worth, Shreveport, Mt. Pleasant, Michigan; Salem, Ill.; Borger, Texas; Wichita Falls, Texas; Midland, Texas; Lafayette, La.

Long Beach, Casper: Dowell Associate—International Cementers, Inc.



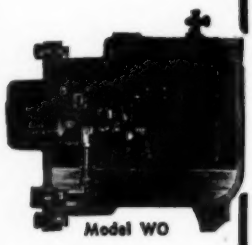
Dowell service is supervised by trained engineers using carefully selected liquid solvents and special mobile equipment.

DOWELL

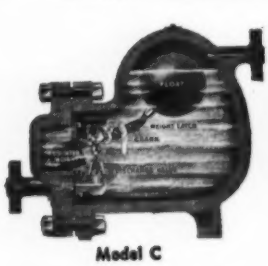
FOR INDUSTRIAL CHEMICAL SERVICE

DO YOUR STEAM TRAPS 'COOK' DRY AND LEAK?

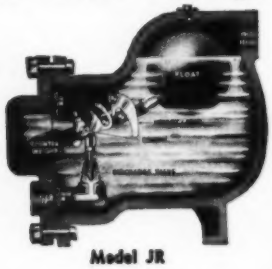
Nicholson Weight-Operated Traps Effect Substantial Steam Savings



Model WO



Model C



Model JR

7 FEATURES liked by Maintenance Men

1) Leak-proofed by fluid seal over valve.
2) Not dependent on buoyancy of float.
3) Unaffected by re-evaporation.
4) Non-wire drawing.
5) Rugged, to take unavoidable abuse.
6) Not easily affected by dirt, pulsation.
7) Of stainless steel where it counts.

If you are losing live steam in superheated service, because traps leak, Nicholson weight-operated traps offer a now widely adopted remedy. Though "cooked" dry, the valve of these traps holds tight due to its weight operation. Steam savings in remarkable quantities are reported from some installations. Types for every application and pressure to 1500 lbs.

Catalog 444 or see Sweet's

W. H. NICHOLSON & CO.
125 OREGON ST. WILKES-BARRE, PA.
Valves ★ Traps ★ Steam Specialties

HERE'S MY HONEST OPINION....

"When I bought my Viking pumps, I knew they were engineered for my job. They were no off-the-shelf item that was supposed to do a little of everything and none too well.

"They were built for my work and to handle my particular problem. There was no guessing or compromising.

"My pumps today are several years old. They have needed little repairing. The newer Vikings are even better than mine although harder to get than when I bought them. They cost a little more but they are still an honestly good buy.

"Vikings are simple, rugged and well built. They always have been and I think they always will be. That's why I'm going to get more Vikings when I need more pumps.

"Your first step is to ask for free folder 47SW. If you have a pumping problem, tell them about it."

VIKING PUMPS — VIKING PUMP CO. CEDAR FALLS IOWA

See Our Catalog In SWEETS

Viking PUMP COMPANY Cedar Falls, Iowa

New Equipment

(*Continued from page* 122)

and No. 4 anthracite, or a mixture of both. Unit comes in sizes built for cast-iron sectional, steel firebox or brick-set boilers of steaming capacities from 1250 to 12,500 lb per hr. **R B McClave Engrg Co, 149 Broad St Station Bldg, Philadelphia 3, Pa.**

Car-Door Operator E22

ELEVATOR-CAR DOOR opens and closes by simple torque-motor operator. Motor drives operator through V-belt. A sprocket on the driven V-sheave shaft connects by roller chain to either side of the operator's head wheel. An arm extends from this wheel to the car door where it terminates in a ball-bearing roller between two guides on outside of car door.

When torque motor turns head wheel clockwise, free end of arm throws to the left and moves car door to closed position. Reversing torque motor throws arm to right to open the door. Length of arm is adjusted so that when it is thrown to a horizontal position the car door is either fully open or closed.

Since the door cannot be opened any farther than the arm permits, dashpots, bumpers and other checking devices are not required to arrest door's motion at end of travel. Because roller in the end of the arm describes a semicircle in its travel from one limit of travel to the other, rate of door acceleration is zero at beginning of door travel, increases to a maximum at midposition, and decreases to zero at the end travel, as it should for smooth operation.

To prevent a passenger being injured if

AVOID THE LUXURY TAX

on Idle Horsepower

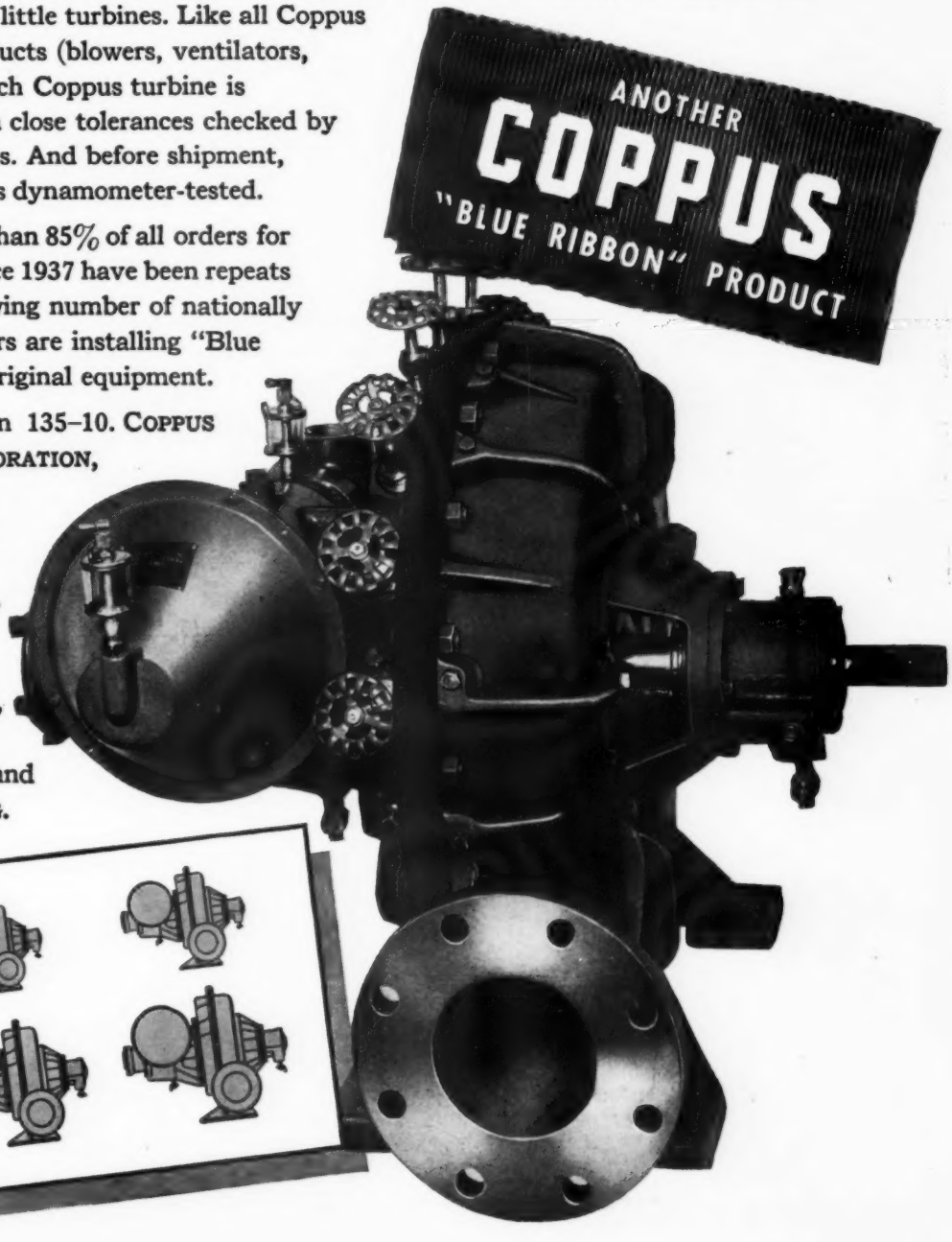
When your horsepower needs are small, why pay the extra cost of larger turbines, designed for much more power than you require?

You pay only for the horsepower you need when you fit the right Coppus "Blue Ribbon" Turbine to the load. They're made in six frame sizes . . . from 150 hp down to fractional . . . priced in proportion to their size.

That's why you'll see more and more Coppus turbines powering pumps, blowers, fans, stokers and other equipment requiring a steady source of small hp. *Steady* is the word for these busy little turbines. Like all Coppus "Blue Ribbon" products (blowers, ventilators, gas burners, etc.) each Coppus turbine is precision-made, with close tolerances checked by Johansson size blocks. And before shipment, the turbine you get is dynamometer-tested.

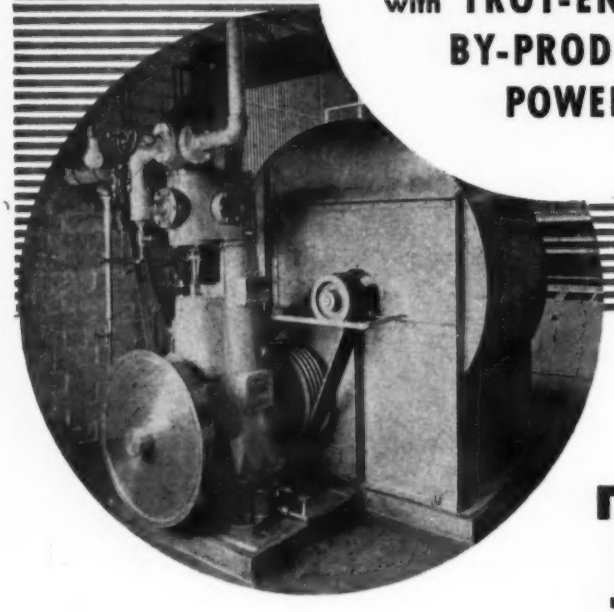
No wonder more than 85% of all orders for Coppus turbines since 1937 have been repeats . . . and that a growing number of nationally known manufacturers are installing "Blue Ribbons" on their original equipment.

Write for Bulletin 135–10. COPPUS ENGINEERING CORPORATION, 161 Park Avenue, Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG and REFINERY CATALOG.



ARE *You* WASTING BOILER HORSEPOWER ?

GET *Maximum* STEAM EFFICIENCY with TROY-ENGBERG BY-PRODUCT POWER



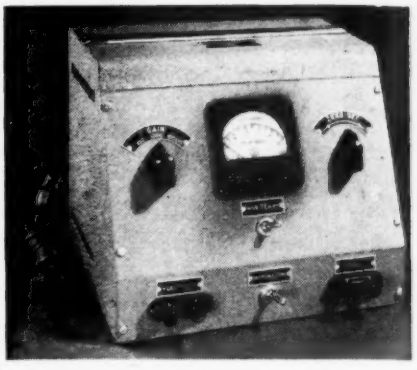
The modern Troy-Engberg Steam Engine is designed to extract the power from the steam you produce before it passes, with little loss in heating value, into your heating or processing cycles. The steam engine acts as a reducing valve but it's a reducing valve that generates power or drives equipment and then exhausts most of the heat units into your processing or heating lines.

The modern Troy-Engberg Steam Engine also offers the following advantages — wide speed range, high overload capacity, high starting torque, conservative speed, exceptional dependability. Investigate this drive for your stokers, fans, pumps, compressors and generators.

TROY ENGINE & MACHINE COMPANY
(Established 1870)
2500 Railroad Avenue Troy, Pennsylvania

TROY-ENGBERG
STEAM ENGINES • GENERATING SETS • GENERATORS

car door should hit him, torque motor is adjusted so it has only sufficient power to close door easily. With little effort a passenger can stop the door in any position. In addition, an electronic-tube timer holds car gate open at the floors to give ample time to get off or on before the car closes. **Maintenance Co, 453 W 42nd St, New York 18, N. Y.**

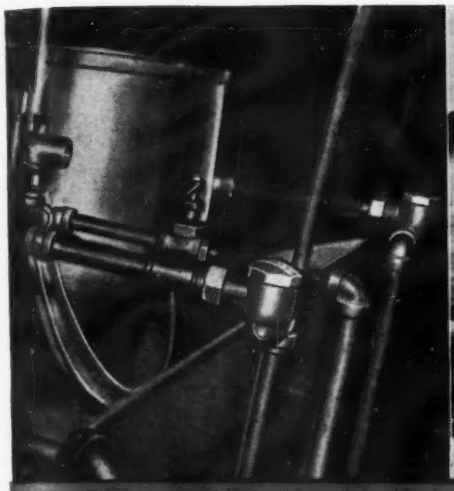


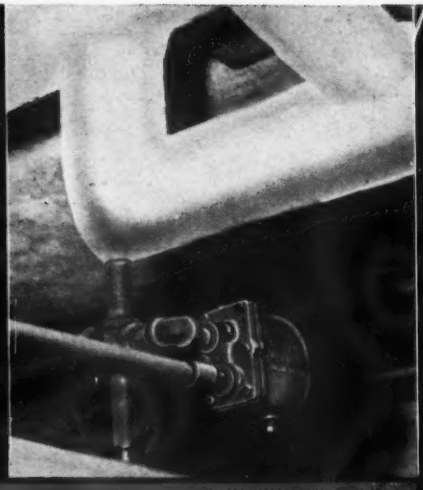
Dc Amplifier E23

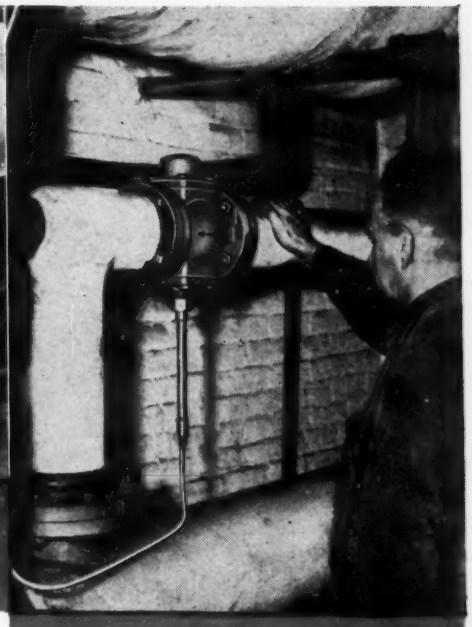
MICROSEN AMPLIFIER measures and amplifies minute power impulses as low as 0.2 micro volts. Power inputs from ionization, photoelectric cells, thermocouples, or wheatstone bridge, are amplified by an electromechanical balance, which gives an output signal directly proportional to the input signal. The amplifier has an isolated input circuit that is insulated from output to ground. Input is measured and output stabilized through a feedback circuit. The instrument incorporates a mechanical zero adjustment with sufficient range to permit operation from various reference voltages. It has an adjustable gain, no lower frequency limit, and low-input resistance. **Manning, Maxwell & Moore, Inc, Bridgeport 2, Conn.**

Hoist Jack E24

COMBINATION HOIST AND JACK designed to move or lift heavy loads in shops, industrial plants, construction and other fields. Hoist jack is complete in three pieces (stand, hoist and handle) has 2000-lb capacity and weighs 23 lb. It uses ratchet-and-pawl







USE THIS SARCO SERVICE

The word "Sarco" means far more than a complete line of high quality steam traps and temperature controls.

It means that whenever you doubt the end-result efficiency of the fuel, heat or water you buy, or when you feel that controlled temperatures in your plant operations would speed production and reduce costs, *there is a Sarco Representative in your vicinity who can apply a quarter of a century experience on your special problems without cost for the service.*

He can show you how to get the most out of every dollar's worth of fuel in the first place — and how to use left-over heat for other purposes. If you think your boiler is not large enough, it would be wise to see that the way you are using its present output is at maximum efficiency.

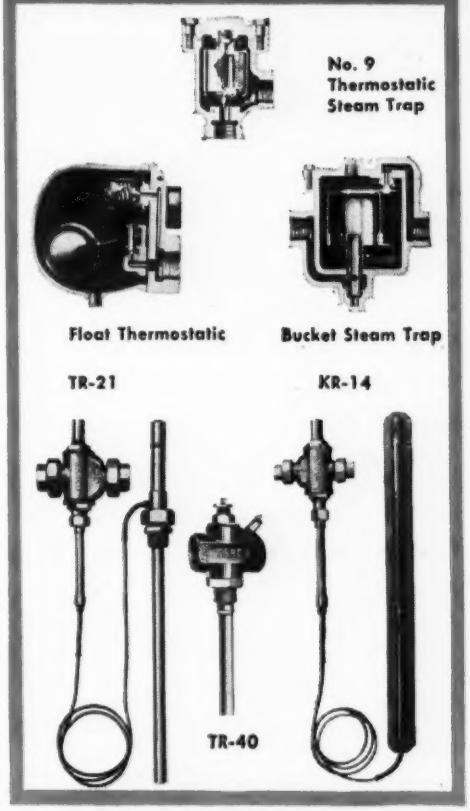
If your processes would be better with temperature control, or if your heating system is unsatisfactory, a word to Sarco will bring the help you need.

Then you will appreciate the completeness of Sarco Service and the Sarco line of products.

Seldom has industry been offered devices that cost so little and do so much — for the speed, reliability and cost of production; for the protection and comfort of employees, and for economy of fuel and water.

A phone call to "Sarco" will show you how.

As well as Sarco Steam Traps and Control



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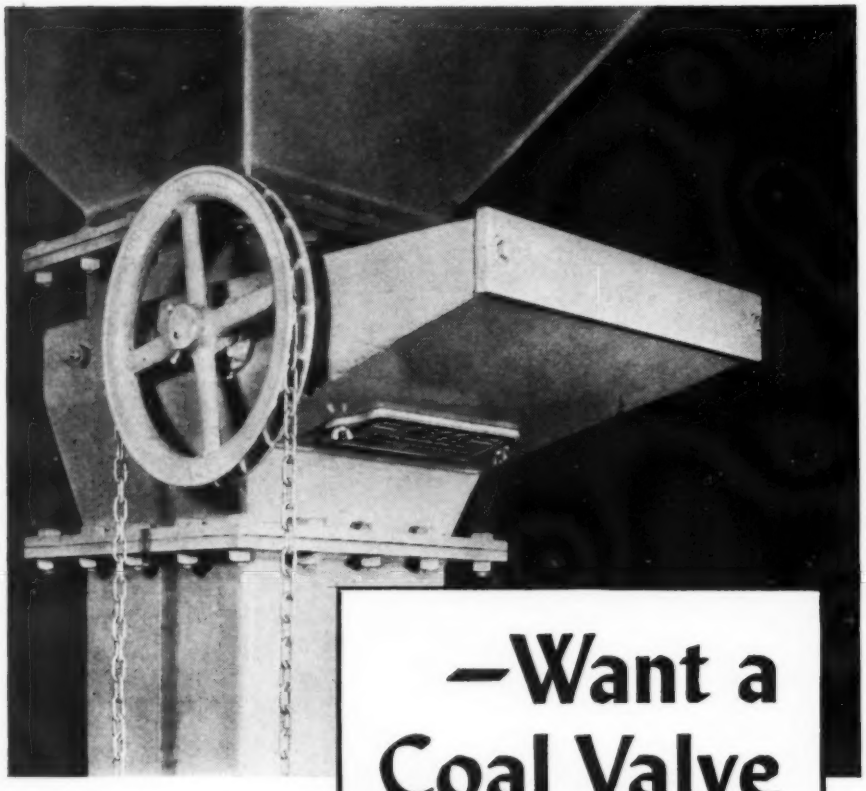
SARCO SAVES STEAM

SARCO COMPANY, INC.
Represented in Principal Cities
Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 5, ONTARIO



—Want a Coal Valve to CLOSE?

S. E. Co.
COAL VALVES WILL!

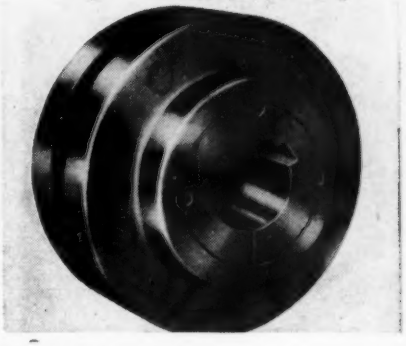
S. E. Co. Coal Valves are equipped with *two* driving racks and pinions! The effect gained by this construction is to keep the gate in a S. E. Co. Coal Valve in perfect alignment and free-moving at all times. Furthermore, all working parts are completely shielded to keep coal particles and moisture from causing deterioration and binding.

Write for illustrated bulletins and data sheets. Address STOCK ENGINEERING COMPANY, 715 Hanna Bldg., Cleveland 15, Ohio.

STOCK
ENGINEERING CO.

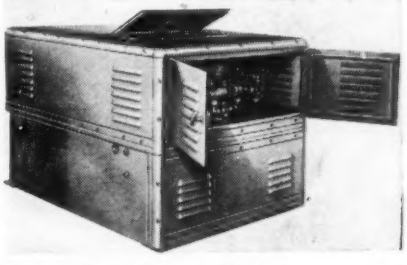
★
CONICAL
Non-Segregating
Coal Distributors
★
S.E.CO.
Coal Valves and Coal Scales

construction and has safety handle that bends on overloads. When taken apart, hoist jack is sufficiently compact to be carried in tool box. It is for all-round shop and plant use for lifting or pulling work. **Coffin Hoist Co, Danville, Ill.**



Flexible Couplings E25

PIN-TYPE FLEXIBLE COUPLINGS have taper-lock bushing previously used with V-belt sheaves. Bushing insures fastening coupling to shafts with shrink-fit tightness and eliminates reboring. Coupling center disk of oak-tanned sole leather provides flexibility and strength. It has no projecting parts. Center disk can be easily removed by loosening coupling flanges and sliding them apart on their shafts. Large-diameter centerless ground pins pressed in flanges are easily removed. Coupling machined all over to insure balance and true running. **Dodge Mfg Co, Mishawaka, Ind.**



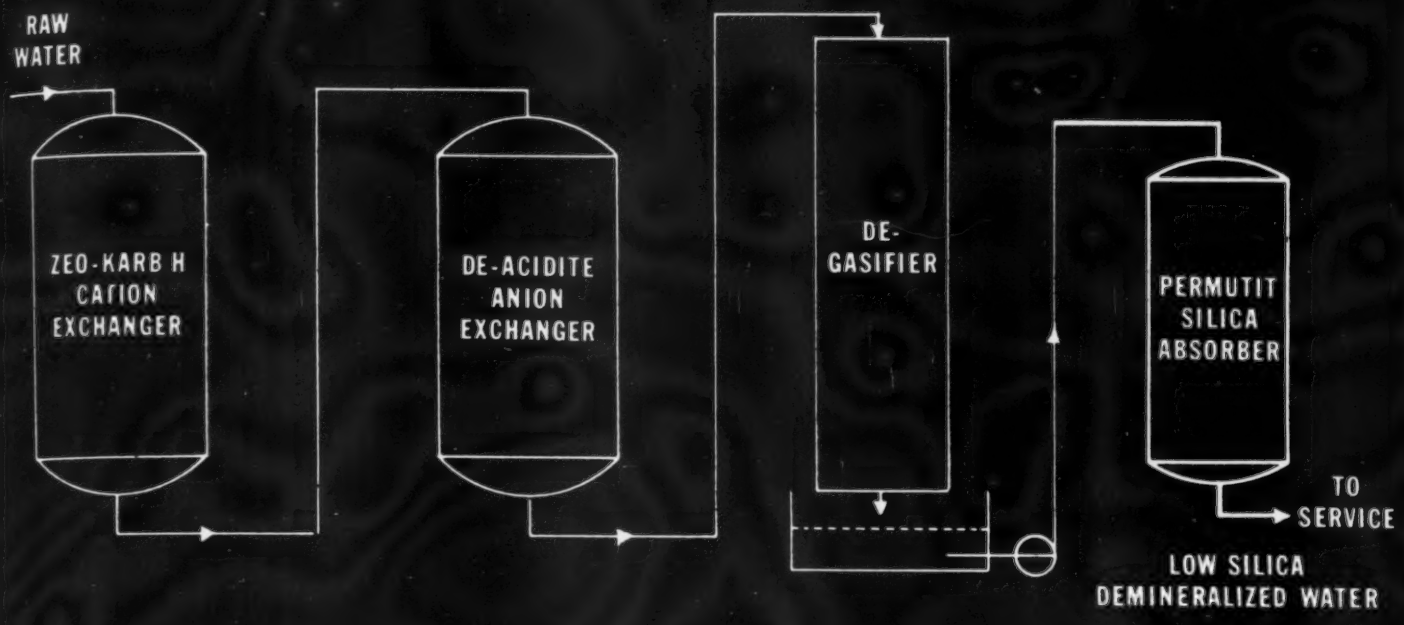
Hydraulic-Power Units E26

CUSTOM-BUILT HYDRAULIC POWER UNITS are for special requirements of industrial machinery. Units include all necessary valves, pumps, oil reservoirs, intermediate piping, motors and air cleaners in a single casing. Hydraulic connections to the driven machine are grouped in a conveniently located manifold for simplicity of installation and maintenance. **Vickers, Inc, 1596 Oakman Blvd, Detroit, Mich.**

Electric Hoist E27

RUGGED CONSTRUCTION, low-operating costs feature new line of *Whippet* electric hoists. Capacities range from 250 to 2000 lb, with cross or parallel-mounted trolleys. Standard lift is 12 ft, but 20 ft can be furnished.

Hoist has pushbutton control, preformed wire rope, grooved drum, motors that meet NEMA standards. **Ford Chain Block Div, American Chain & Cable Co, York, Pa.**



SILICA REMOVAL
combined with
DEMINERALIZATION!

HERE'S AN ECONOMICAL NEW CHEMICAL PROCESS FOR PRODUCING THE EQUIVALENT OF DISTILLED WATER!

The Permutit* two-step Demineralizing process utilizes Zeo-Karb H, Permutit's acid-regenerated cation exchanger to replace metallic cations with hydrogen ions, converting salts present into corresponding acids. These acids are then removed from solution by De-Acidite, Permutit's resinous anion exchanger.

Permutit has pioneered by adding to the Demineralizing process a new, one-step cold process silica removal treatment which removes silica down to less than 0.5 p.p.m.—making possible ideal, low silica, demineralized boiler-feed make up!

• • •

For information about this revolutionary new, low first cost, low operating cost treatment, address The Permutit Company, Dept. P-1, 330 West 42nd Street, New York 18, N. Y., or the Permutit Company of Canada, Ltd., Montreal.

*Trade Mark Reg. U. S. Pat. Off.

for 34 years

Permutit

WATER CONDITIONING HEADQUARTERS

WATER CONDITIONING • ION EXCHANGERS • MATERIALS AND EQUIPMENT

"GUNITE" Concrete

(since 1915)

Linings for

STEEL BUNKERS •
DUCTS, HOPPERS •
STACKS •
UPTAKES •
BREECHINGS •
STEEL & PIPE •
ENCASEMENT •
FIREPROOFING •

GUNITE CONCRETE & CONST. CO.

1301 Woodswether Road
KANSAS CITY 6, MO.

R. N. Turner, Dist. Mgr., 228 Nor. La Salle St., Chicago 1, Ill. B. H. Mueller, Distr. Mgr., 6625 Delmar Blvd., University City, (St. Louis), Mo. Philip D. Barnard, Distr. Mgr., 2036 Addison, Houston 5, Tex.

Branch Offices: New Orleans, Dallas, Denver.

Makes ALL VALVES *INSTANTLY* Accessible

CONTROL FROM THE FLOOR

● Instant, handy, safe control of overhead and other out-of-reach valves. Eliminate danger to employees; banish the stepladder. Now — install valves anywhere they should be, regardless of accessibility.

Inexpensive BABBITT Sprocket Rims fit all types and makes of valves, with either rising or non-rising stems. Installed quickly by clamping directly onto hand wheel of valve. Eliminates makeshift apparatus and specially-made chain wheels.

● Ten standard sizes take care of all valve wheels from 2 to 30 inches in diameter.

● *Request Catalog Bulletin P, prices, name of local distributor:*

Babbitt *Adjustable* SPROCKET RIM *with Chain Guide*

BABBITT STEAM SPECIALTY COMPANY
Manufacturers of Adjustable Valve Operating Mechanisms
New Bedford, Mass., U. S. A.

ALLPAX

. . . the PACKING that packs ALL

ALLPAX is the *universal* packing for general service . . . for all stuffing boxes of any size or shape . . . for steam, water, air ammonia, oils, gases, distillates, etc., where temperature does not exceed 600F.

With ALLPAX there is no necessity to keep on hand a special packing for this or that use. You can standardize on ALLPAX for *all general* purpose uses and be assured of long-lived, economical service wherever it is used.

ALLPAX is a combination of long, tough fibres of asbestos, thin flakes of highest grade anti-friction metal, minute flakes of graphite, and a special non-liquid heat-proof lubricant, compounded to assure long-wearing, leak-proof, non-scoring packing for severe service. Its low friction cuts down power losses and improves efficiency.

Special styles available for special service.

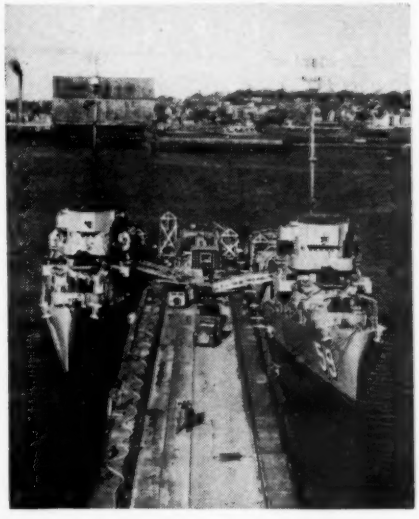
Try ALLPAX once and you'll use it always. Distributors everywhere.

THE ALLPAX COMPANY, INC.

Mamaroneck, New York

Power News

(*Continued from page* 132)



Destroyer-Escorts Foss (right) and Maloy are shown tied up at dock in S. Portland

to cooperate by curtailing nonessential uses of electricity and to retail merchants with plans for holiday-season decorative street lighting.

St. Lawrence Seaway Again. Curtailment of power in northern New York states resulting from the Fall drought brought renewed demands for early construction of the St. Lawrence seaway, backers of the project claiming that such cutbacks "prove" there is a "serious power shortage" in the area.

R E Howe, president of Appalachian Coals, Inc, Transportation Bldg, Cincinnati, Ohio, announces that Haehnle Advertising has been retained to conduct a long-range public-service program. Newspapers and the radio will be used, as well as other media. First presentation of projected program was made to a meeting of board of directors of Appalachian Coals by Haehnle Advertising Agency on Oct. 15. The directors unanimously voted to submit their outlined plan to stockholders. The special meeting, held on Oct 28 in Cincinnati, is believed to be first of its kind where stockholders were asked to appear for the purpose of passing on a long-range program to acquaint employes and the public at large with true facts about coal, and thus improve relations among the industry, its employes and the public.

President Truman's Certificate of Merit for outstanding service in production of diesel-engine equipment for naval ships and submarines was awarded George W Codrington, vice-president of General Motors and general manager of that firm's diesel engine div, by John L. Sullivan, Secretary of Navy.

If you designed your own boiler — you would be sure it had Plenty of Guts!

Water Tube Design

Inclined Tubes

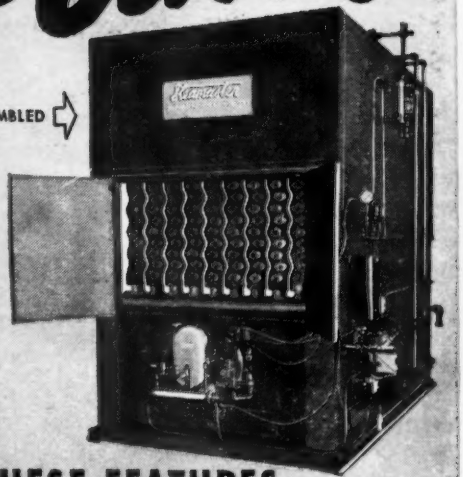
Sectional Steel Headers

Longitudinal Drum

The GUTS of the Steamaster Boiler

Steamaster Builds Boilers with PLENTY OF GUTS!

COMPLETELY SHOP ASSEMBLED



CHECK *the features you would include if you designed your own boiler*

- ☐ Water Tube Design.
- ☐ Inclined Tubes.
- ☐ Sectional Steel Headers.
- ☐ Longitudinal Drum.
- ☐ All Steel Construction.
- ☐ Positive Tidal Circulation of Water —maintains all parts at equal temperature.
- ☐ Condensate Return System built-in as an integral part of all boilers of 60 h.p. and up.
- ☐ Easy Inspection and Maintenance —every tube immediately accessible. Just open the heavily insulated access doors.
- ☐ Large Combustion Area — Three-pass heat baffling gives high thermal efficiency.
- ☐ Choice of Fuel—gas, oil or coal or any combination of these fuels to meet fuel requirements of your plant.
- ☐ Fully Equipped for Automatic Operation—with the finest accessories. As nearly automatic as a boiler can be.
- ☐ A.S.M.E. CODE—National Board Approved. Inspected and certified by Hartford Steam Boiler Inspection and Insurance Co.
- ☐ Full Range of Sizes from 10 h.p. to 300 h.p. as illustrated. The Model A for 3½ h.p., 5 h.p. and 7½ h.p.
- ☐ Can Be Fired Over Rated Capacity and still maintain high thermal efficiency.

THESE FEATURES..... are built in all steamaster Boilers from 10 horsepower to 300 horsepower.

Steamaster

AUTOMATIC BOILER CO.

Compton at Slauson Los Angeles 11

SALES AND SERVICE IN ALL PRINCIPAL CITIES

Power Engineers Agree: STEAMASTER is the Boiler with PLENTY OF GUTS!

A MERCOID
UNFAILING ADVANTAGE

Whatever your control requirements may be, it is conceded that the switch in a control warrants first consideration, due to its functional characteristics. All Mercoid Controls are equipped exclusively with hermetically sealed mercury switches of special design and selected materials.

Mercoid mercury switches are known the world over for their dependable service. They are not affected by dust, dirt or corrosion; nor are they subject to open arcing with its attendant consequences of pitting, sticking or oxidized contact surfaces, all of which, are likely to interfere with normal switch operation.

That is why among other things, Mercoid Controls on the whole give you assurance of better control performance and longer control life—a distinct and unfailing advantage—the reason why they are also the choice of America's leading engineers for many important industrial applications.

MERCOID CONTROLS are available in a variety of types for sensitive control of Pressure, Temperature and Lever actuation.

MERCOID
APPROVED CONTROLS

THE MERCOID CORPORATION
4201 BELMONT AVENUE • CHICAGO, ILLINOIS

NAPE Starts Long-Range Educational Program

National education committee has in its initial meeting established the preliminary outline of what, it is hoped, will be a long-range project for the National Association of Power Engineers. This program consists of five separate projects as follows:

1. Records are to be made of round-table discussions on various phases of power-plant operation and maintenance. The men who will collaborate in these discussions are the best operating engineers and representative manufacturers' engineers available in metropolitan New York area. These recordings will be on four 12-in. records with an approximate playing time of 30 min. As many copies of such recordings as are necessary are to be made and they will be available to chapters desiring to use this project in their educational programs. There will be no charge for the material.

2. Sound-slide films are to be made on various operations of power-plant procedure: Specific power-plant operations will be selected, for example, operation and maintenance of all oil-burning equipment. Again, this material is available without charge to all NAPE chapters wishing to use it in their local educational program.

3. Representative committee will be formed from outstanding manufacturers of specific power-plant equipment and materials, for example, there will be sections on turbines, centrifugal pumps, water treatment, and steam boilers. Each section will release impartial monthly bulletins relative to operation and maintenance of particular types of equipment represented by the respective section. Such releases will go direct to educational chairman of individual chapters. There will be no charge for this service.

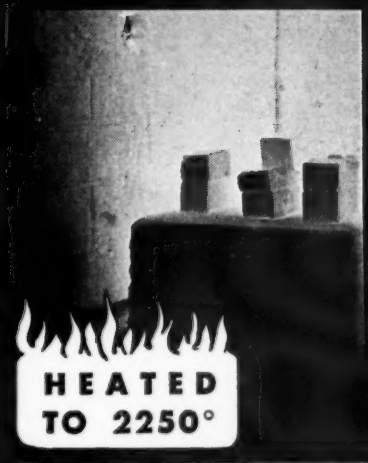
4. A bulletin on questions and answers, covering all phases of power-plant operation, will be released each month. This will also go direct to educational chairmen without charge.

5. Each state where NAPE chapters are located will have a state coordinator of education who will in every way possible aid, facilitate and expedite the national education program.

The program, as outlined above, will be offered to those chapters desirous of using its services. A bulletin will also be released listing most successful local educational plans now in use, so that a chapter without a definite plan may choose a pattern from those that trial has proved most effective.

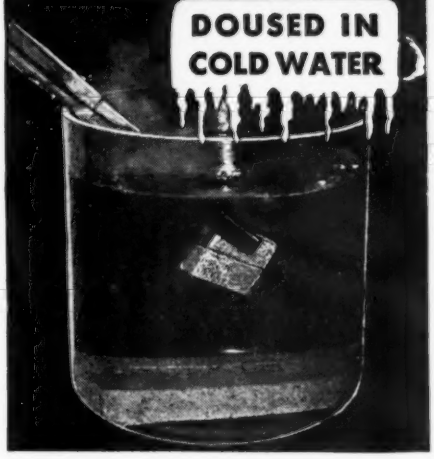
The City of Jacksonville, Fla. will spend about $15,000,000 for rehabilitation and expansion of the municipally owned electric system. The expansion calls for a new power plant, equipped with two 30,000-kw generating units. A second program involves modernizing the water system and installing water-softening equipment. Reynolds, Smith and Hills, architects and engineers, will be consultants for both programs.

Demonstrating
BRICKSEAL
REFRACTORY COATING



Brickseal provides a crackproof, vitrified armor for furnace linings. The small firebricks shown in the furnace were bonded and painted with Brickseal and heated to 2250°. Directly from the furnace they were plunged into cold water as shown below—a test for *any* material subject to expansion and contraction.

Brickseal is *semi-plastic when hot,* yet *hard and tough when cold.* Brickseal is made in grades suitable to heats ranging from 1400° to more than 3000°. It will make any furnace last longer by giving new life to your refractories. Write or call local dealer for a demonstration.



BRICKSEAL
REFRACTORY COMPANY
5800 S. Hoover St., Los Angeles, Cal.
158-14th St., Hoboken, N. J.

Engine performance at its best with crankshafts on Timken bearings

BY using Timken bearings at both ends of the crankshaft in their heavy-duty air-cooled engines, Wisconsin Motor Corporation insures trouble-free operation. End play is eliminated. Crankshaft and attached parts are held accurately in line, resulting in better performance and longer life. Lubrication is simplified.

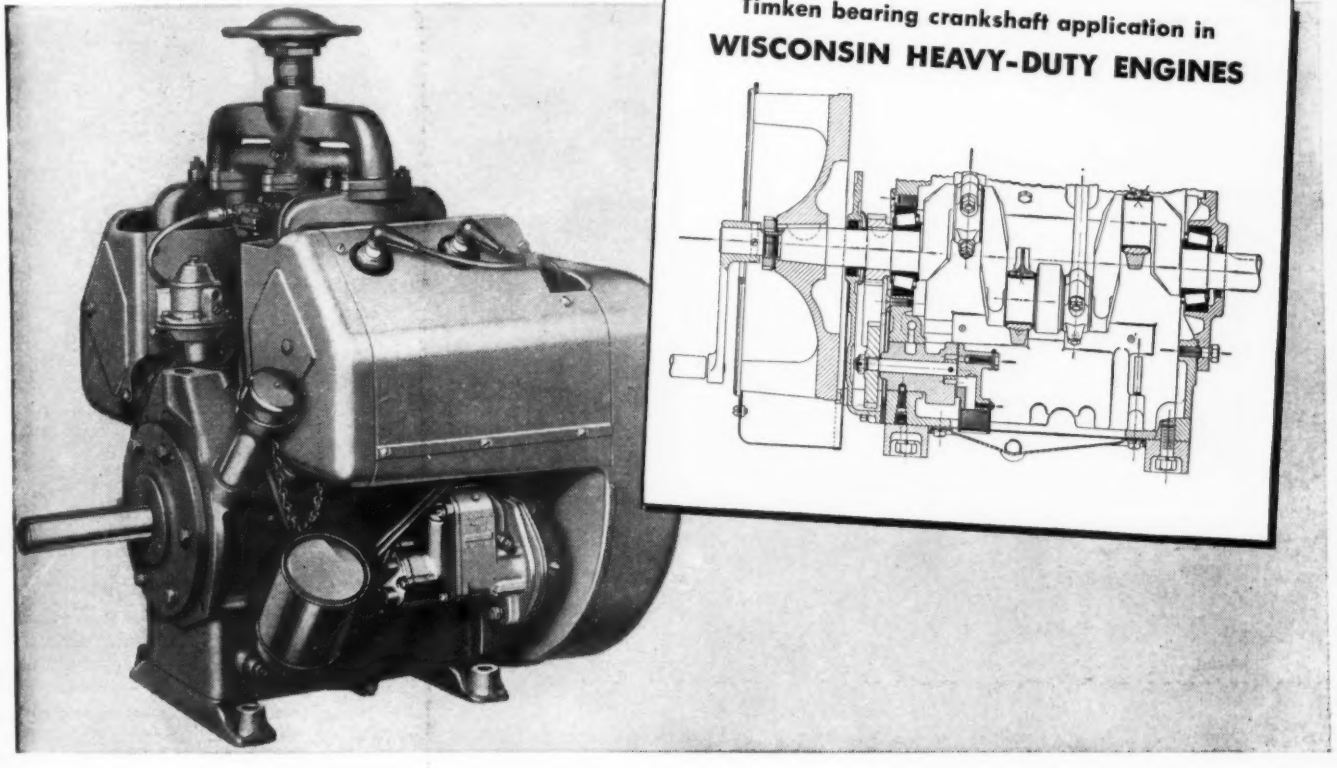
Timken bearings hold moving parts in proper alignment because their tapered construction carries both radial and thrust loads and eliminates end play. Maximum support is provided by the line contact between rolls and races.

With Timken bearings, friction is negligible. Timken bearings are manufactured to extreme accuracy, with amazingly smooth surfaces. They retain this friction-free precision because of their true rolling motion and the Timken fine alloy steel of which they are made.

To be sure of long-time, trouble-free crankshaft performance, make sure the trade-mark "Timken" is on every bearing you use. Timken bearings are backed by 49 years of bearing research and development. No other bearing can give you *all* the advantages of Timken bearings. The Timken Roller Bearing Company, Canton 6, Ohio.

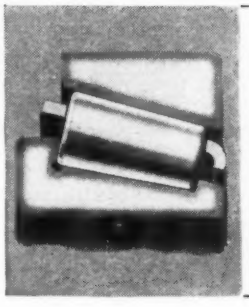
TIMKEN BEARING EQUIPPED

This symbol on a product means its bearings are the best.



Timken bearing crankshaft application in

WISCONSIN HEAVY-DUTY ENGINES



GREATER LOAD AREA

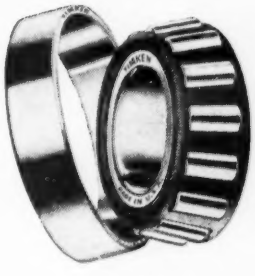
Because the load is carried on the *line* of contact between rollers and races, Timken bearings carry greater loads, hold shafts in line, wear longer.

The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

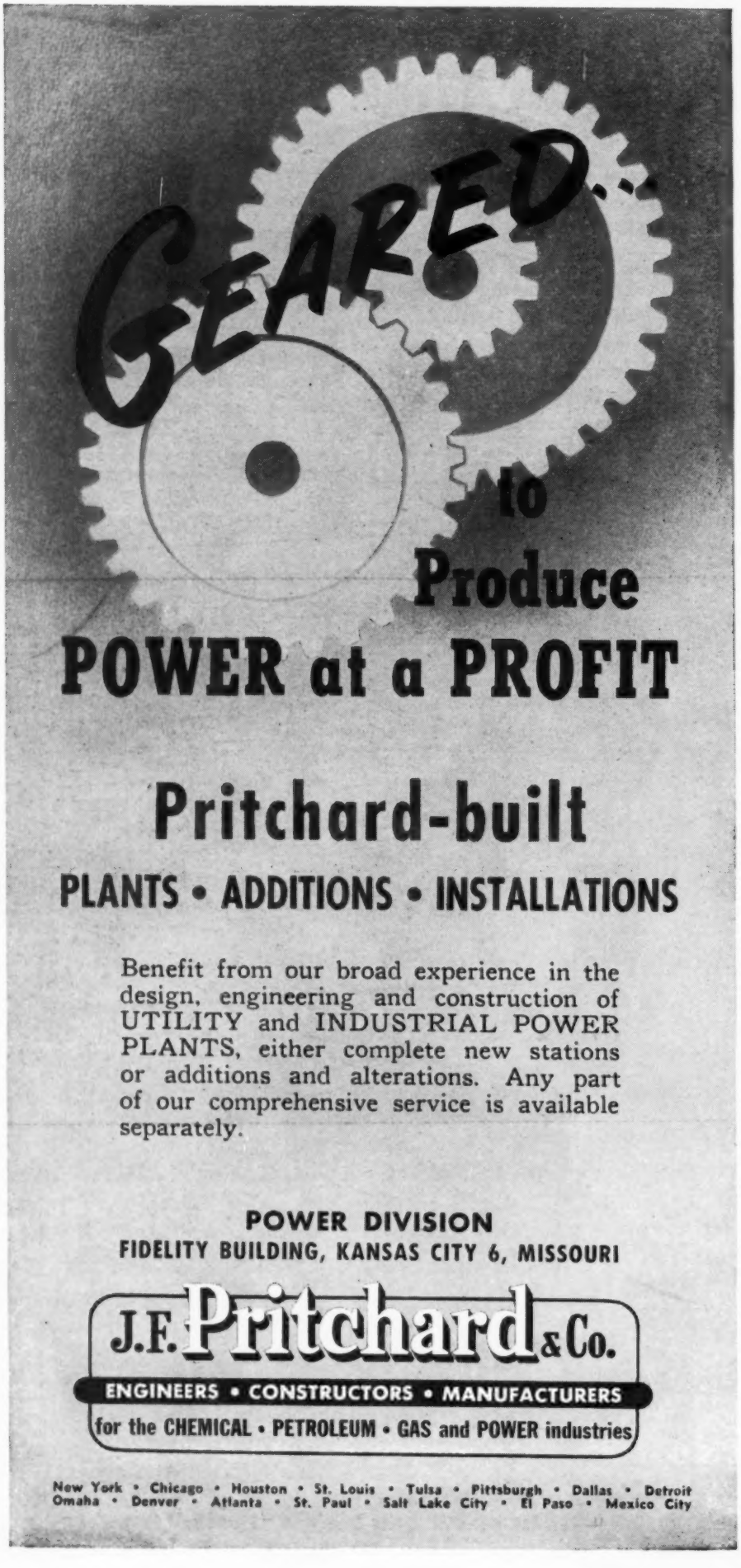
TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION


GEARED...
to
Produce
POWER at a PROFIT
Pritchard-built
PLANTS • ADDITIONS • INSTALLATIONS
Benefit from our broad experience in the design, engineering and construction of UTILITY and INDUSTRIAL POWER PLANTS, either complete new stations or additions and alterations. Any part of our comprehensive service is available separately.
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FIDELITY BUILDING, KANSAS CITY 6, MISSOURI
J.F. Pritchard & Co.
ENGINEERS • CONSTRUCTORS • MANUFACTURERS
for the CHEMICAL • PETROLEUM • GAS and POWER industries
New York • Chicago • Houston • St. Louis • Tulsa • Pittsburgh • Dallas • Detroit
Omaha • Denver • Atlanta • St. Paul • Salt Lake City • El Paso • Mexico City

Unusual Turbines Under Construction

Two turbines of considerable engineering interest are under construction at Westinghouse Electric Corp. Both machines will use steam at high pressure and temperature but will employ steam reheating to an extent greater than usual.

One, a 65,000-kw triple-cylinder design, for Boston Edison Co will use steam at 1450 psig and 1000 F. Steam exhausts at 365 psig from the high-pressure turbine. It returns to a reheat boiler where its temperature is raised back up to 1000 F. From here it enters the intermediate-pressure element of the turbine. The low-pressure turbine has an inlet pressure of about 40 psig and is of double-flow construction.

The second turbine designed for reheat is a 30,000-kw one slated for Dow Chemical Co. It has a complicated automatic-extraction job to perform. Design pressure is 1250 psig, 825 F at the throttle. Steam is extracted at 425 and 165 psig. It exhausts at 25 psig. A hydraulic governing system controls the machine.

Work Starts on Hungry Horse Dam

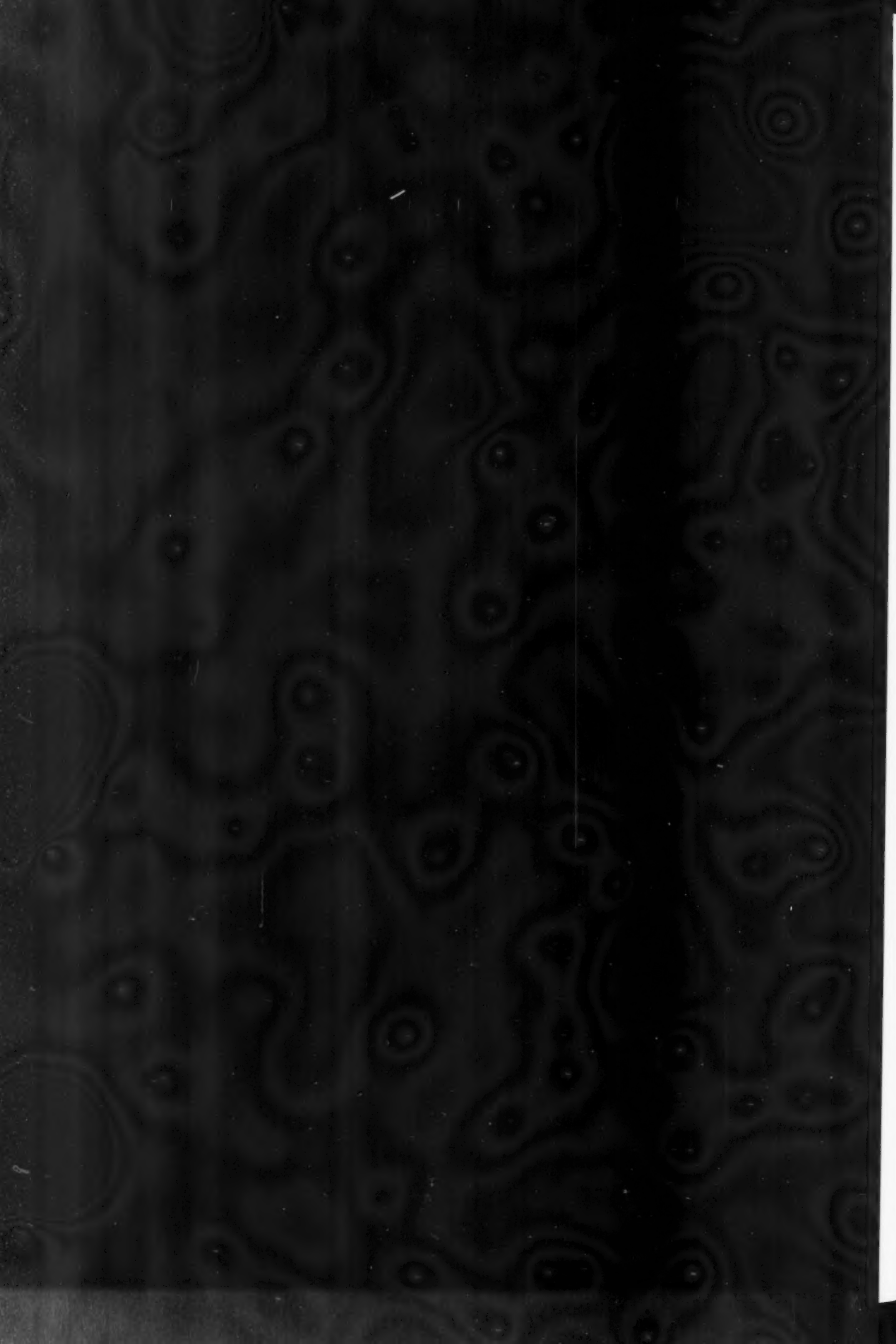
Chief engineers office of the Bureau of Reclamation, Denver, called for bids on excavating for a 36-ft diversion tunnel, 1100 ft long at Hungry Horse Dam, Montana.

The tunnnel will divert waters of the south fork of Flathead River during the construction of the dam itself next spring; 45,000 cu yd are to be removed to form the horseshoe-shaped tunnel.

Hungry Horse Dam is expected to create a 3,500,000 acre-ft reservoir for irrigation in that area. In addition the reservoir will increase the firm power capacities of power plants on the Columbia River. The dam will be an arch-gravity structure 520 ft high and 2130 ft long.

I-T-E-Circuit Breaker Co acquired Railway & Industrial Engrg Co as a subsidiary Nov 1. Amalgamation of the two companies, effected through a transfer of stock, unites two major manufacturers of electrical switchgear whose apparatus lines are supplementary. I-T-E's business has been built largely around indoor air-circuit breakers up to 5000 v, as well as metalclad switchgear for power-station auxiliary service and industrial distribution systems. R&IE business has been chiefly high-voltage, outdoor switching apparatus in voltage range between 5000 and 287,000 v.

The present intention is to have I-T-E plant at Philadelphia and R&IE plant at Greensburg, Pa., continue to make their present products. R&IE will operate under its established name with its present management personnel virtually unchanged. W M Scott Jr will be president of both companies. B W Kerr, formerly president, and K S Nevin, vice-president, treasurer and general manager of R&IE, became directors of I-T-E.



Reader Service Page for . . .

NEW EQUIPMENT and TECHNICAL LITERATURE

Use the FREE service cards for additional information on this month's new products or for copies of latest trade catalogs.

NEW PRODUCTS & MATERIALS

See pages 118-122, 170-174

Circuit Breaker .....page 118
Gate Valve .....page 118
Gear Rotary Pumps.....page 118
Boiler Control .....page 118
Proportional Oil Filter.....page 118
Fluid-Drive Elevator .....page 118
Hydraulic Transmission .....page 120
Condensate Drainer .....page 120
Axial Flow Fans.....page 120
Dewpoint Recorder .....page 120
Lubricated Valves .....page 120
Humidity Indicator .....page 120
Thread Compound .....page 122
Tachometer .....page 122
Gridded Bearings .....page 122
Gearless Pumps .....page 122
Finned Tubes .....page 122
Selector Valves .....page 122
Distribution Transformer .....page 122
Flow Indicator .....page 122
Automatic Stoker .....page 122
Car-Door Operator .....page 170
Dc Amplifier .....page 172
Hoist Jack .....page 172
Flexible Couplings .....page 174
Hydraulic-Power Units .....page 174
Electric Hoist .....page 174

MANUFACTURERS' BULLETINS

See page below and pages 180b-186

Air Conditioning, Heating, Refrigeration, Ventilating .....page 180a
Boilers and Auxiliaries.....page 180b
Controls, Mechanical .....page 180b
Electrical Equipment .....page 180b
Maintenance and Safety Equipment .....page 180b
Materials Handling .....page 182
Mechanical Transmission .....page 182
Piping Fittings, Valves and Specialties .....page 182
Prime Movers and Accessories....page 184
Pumps .....page 184
Other Equipment .....page 184

AIR CONDITIONING, HEATING REFRIGERATION AND VENTILATING

1 **UNIT HEATERS**—McQuay, Inc, 1600 Broadway N E, Minneapolis 13, Minn. 4-page bulletin No. 320 describes construction of McQuay horizontal unit heaters. 8-page bulletin No. 340 discusses McQuay blower unit heaters. 8-page bulletin No. 756 covers McQuay down-flow unit heaters. Capacities and dimensions are given in each bulletin.

(Turn over for bulletin items)

HOW TO ORDER ADDITIONAL DATA

Be sure to fill out, completely, one coupon for each item of information you order. (See sample, right.) This gives your request authority and helps the manufacturer to address your copy completely.

When you have filled out completely one space for each item of information you want, detach along the scored lines and drop the cards in the mail.

Example

Write here number of item in which you are interested → E17

Your Company Name... Brown Mfg. Co.

Address... 3718 First Avenue, Pottsville, Okla.

Your Name... John Smith

Your Title... Power Engineer

POWER, 330 West 42nd St., New York 18, N. Y.

FILL OUT AND MAIL TODAY! NOT GOOD AFTER APRIL 1, 1948

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Your Name.....

Your Title.....

POWER, 330 West 42nd St., New York 18, N. Y. 1/48

2 AIR-CONDITIONING SYSTEMS — Frick Co, Waynesboro, Pa. 12-page bulletin No. 505-C gives principles of air conditioning most generally used for human comfort. This bulletin shows special applications for each principle. 8-page booklet describes various community refrigeration centers.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ **AIR DIFFUSERS**—W B Connor Engrg Corp, 114 E 32nd St, New York 16, N. Y. 32-page bulletin No. K-20 gives all the information and data necessary for proper selection of air diffusers. It presents full catalog data on the several diffuser models and accessories.

3 DUST AND FUME ELIMINATORS—Schmieg Industries Inc, 300 Piquette Ave, Detroit 2, Mich. 12-page folder describes Schmieg Centri-Merge swirl type dust and fume eliminator. Photos and diagrams are included.

BOILERS AND AUXILIARIES

4 BENT-TUBE BOILER—Henry Vogt Machine Co, 10th and Ormsby St, Louisville, Ky. 18-page bulletin covers installations of LE bent-tube boiler.

5 HORIZONTAL ROTARY BURNER—Preferred Utilities Mfg Corp, 1860 Broadway, New York 23, N. Y. 6-page bulletin No. 175 describes a new heavy-oil burner of the horizontal rotary type, with a capacity of 5 to 150 gal per hr.

6 OIL BURNERS — Peabody Engrg Corp, 580 5th Ave, New York 19, N. Y. 4-page condensed bulletins No. 303 and 903 discuss operation of heavy-duty mechanical and steam-atomizing oil burners. Bulletins also describe gas and oil burners for industrial boilers, heaters and furnaces, as well as central-station installation.

7 STEAM GENERATORS—Springfield Boiler Co, 1953 E Capitol Ave, Springfield, Ill. 12-page bulletin covers Springfield line of 2-drum bent-tube and sectional-header cross-drum boilers. Designs featured include Type M standardized boilers for small- and medium-size plants, with complete data and dimensions.

8 COMBUSTION UNIT—National Air-oil Burner Co, 1284 E Sedgley Ave, Philadelphia 34, Pa. Supplement No. 6 to bulletin No. 50 describes National Air-oil Airocool tandem combustion unit for combined gaseous and oil fuels.

9 STEAM GENERATORS — Cyclotherm Corp, 90 Broad St, New York 4, N. Y. 8-page bulletin No. 28 explains principle of cyclonic combustion that enables the Cyclotherm steam generator to operate automatically on any liquid or gaseous fuel. Ratings and dimensions of standard sizes are included.

10 HIGH-PRESSURE BOILERS — Kewanee Boiler Corp, Kewanee, Ill. 16-page booklet describes operation and care of Kewanee high-pressure boilers. Boiler construction is given.

11 BITUMINOUS COAL—Pittston Co, 350 Fifth Ave, New York 1, N. Y. 36-page brochure on the Pittston Co and its associated corporations gives a graphic picture of their far-reaching activities, with particular emphasis on mining, shipping and distribution of bituminous coal.

12 UNDERFEED STOKERS—Erie City Iron Works, Erie, Pa. 12-page bulletin No. SB27-5M-9-47 describes construction of Erie City underfeed stokers. Dimensions of Type L and Type H underfeed stokers are discussed.

13 WATER GAGE AND ALARM—Ernst Water Column & Gage Co, Livingston, N. J. Bulletin No. T gives specifications of Ernstilt adjustable inclined water column and high and low alarm for package boilers.

CONTROLS, MECHANICAL

14 ELECTRONIC SCRIBER — Wheelco Instruments Co, 847 W Harrison St, Chicago 7, Ill. 16-page educational bulletin No. 7 presents the Capacilog, electronic scriber. Operational diagrams, schematic drawings, charts and listings explain diversified functions of the company's new strip chart recorder.

15 FLOAT SWITCH — Automatic Control Co, St. Paul 4, Minn. Bulletin L3 gives construction, operation and application of L200 float switch. Photos and diagrams are included.

16 DIFFERENTIAL PRESSURE CONTROLS—Swartwout Co, 18511 Euclid Ave, Cleveland 12, Ohio. 4-page bulletin No. S-17 explains a new series of precision differential pressure master controls. This bulletin includes hookup diagrams on a number of applications.

ELECTRICAL EQUIPMENT

17 GROUNDING CONNECTORS — Burndy Engrg Co, 107 Breckner Blvd, New York 54, N. Y. 32-page catalog, entitled "Connectors for Grounding," presents the company's line of grounding devices. This publication provides a comprehensive discussion of modern grounding practice.

18 FLUORESCENT LIGHTING — Benjamin Electric Mfg Co, Des Plaines, Ill. Bulletin No. F1, entitled "Guide to Fluorescent Lighting," gives applications and specifications of Benjamin fluorescent lighting line. Photos, diagrams and charts are included.

19 POWER-LINE CARRIER COMMUNICATION — Westinghouse Electric Corp, P O Box 868, Pittsburgh 30, Pa. 8-page booklet No. B-3882 describes the Type JY power-line carrier communications equipment. This booklet discusses 2-frequency duplex, manual simplex and automatic simplex transmitter-receiver assemblies, along with their component parts.

20 FLUORESCENT-TUBE LOUVERS—Photo-Vision, Inc, 35 W 43rd St, New York 18, N. Y. Folder gives advantages of Beauty-Rest louvers on fluorescent tubes for eye protection. Specifications are included.

21 ELECTRICAL LINE — Trumbull Electric Mfg Co, Plainville, Conn. 50-page Trumbulist general catalog, July 1947, presents enclosed safety switches, enclosed circuit breakers, service entrance switches, multi-breaker load centers, motor starters, open knife switches, solderless lugs, panelboards, busways, control centers, switchboards, infrared ovens, etc. Capacities are given.

MAINTENANCE AND SAFETY EQUIPMENT

22 VIBRATION MOUNTS — Hamilton Kent Mfg Co, Kent, Ohio. 8-page bulletin gives advantages of Rexon vibration mounts. Photos, charts, diagrams and tables are included.

(*Continued on page 182*)

FIRST CLASS
PERMIT No. 64
(Sec. 510, P.L. & R.)
NEW YORK, N.Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

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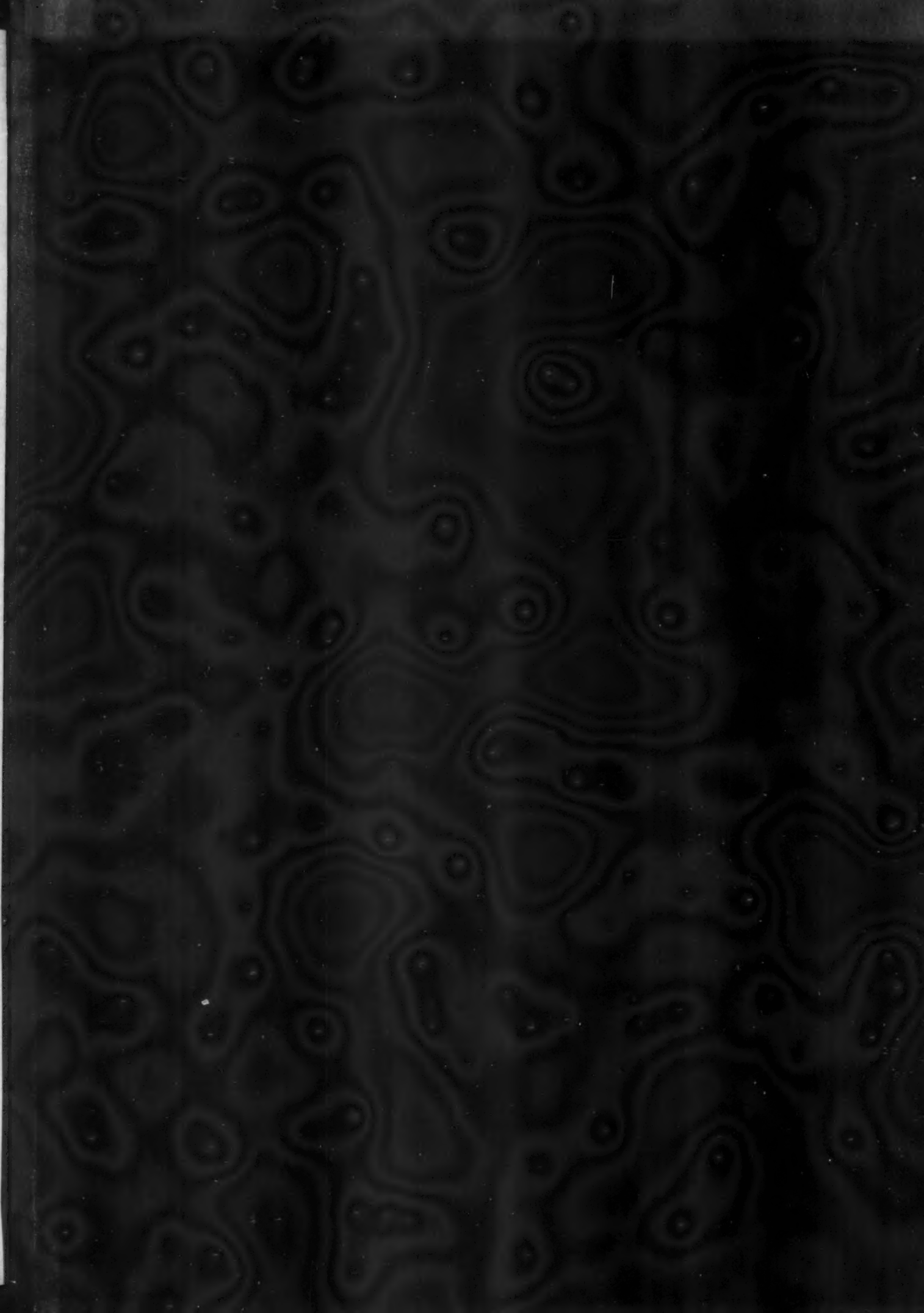


E. B. Badger & Sons Co. is the original and sole manufacturer of BADGER Expansion Joints.

BADGER Packless Corrugated Expansion Joints are built "to take it."

The ALL-CURVE corrugations in Badger Joints, working together with the ALL-CURVE directed-flexing equalizing rings (a patented feature), assure an even distribution of stresses —throughout *each* corrugation, and also over *all* the corrugations. Expansion, contraction and vibration stresses are equalized dependably, permanently.

Special Badger methods of forming the corrugations from a single piece of tubing eliminate the necessity of packing. Hence, costly servicing operations are not required.

The simplicity and compactness of Badger Expansion Joints permit quick, easy installation. And once you install them in steam and other lines, your pipe-expansion problems are solved *once and for all.*

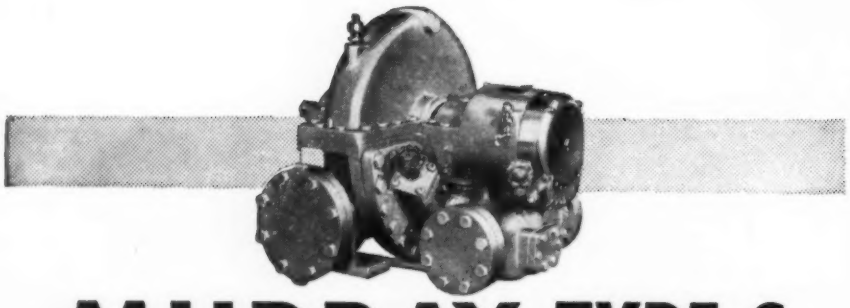
MADE IN COPPER, STAINLESS STEEL AND OTHER ALLOYS—Copper for normal pressures and temperatures; Stainless Steel and other alloys for higher requirements —and where corrosion is a problem. Single or multiple corrugations—for traverses from a fraction of an inch upward. Also made in Non-equalizing type (without rings) for uses that do not require added protection. Send for Bulletin No. 100 (Self-equalizing) or No. 200 (Non-equalizing).

Badger

E. B. BADGER & SONS CO., Cambridge Division, 260 Bent Street, Cambridge 41, Mass.

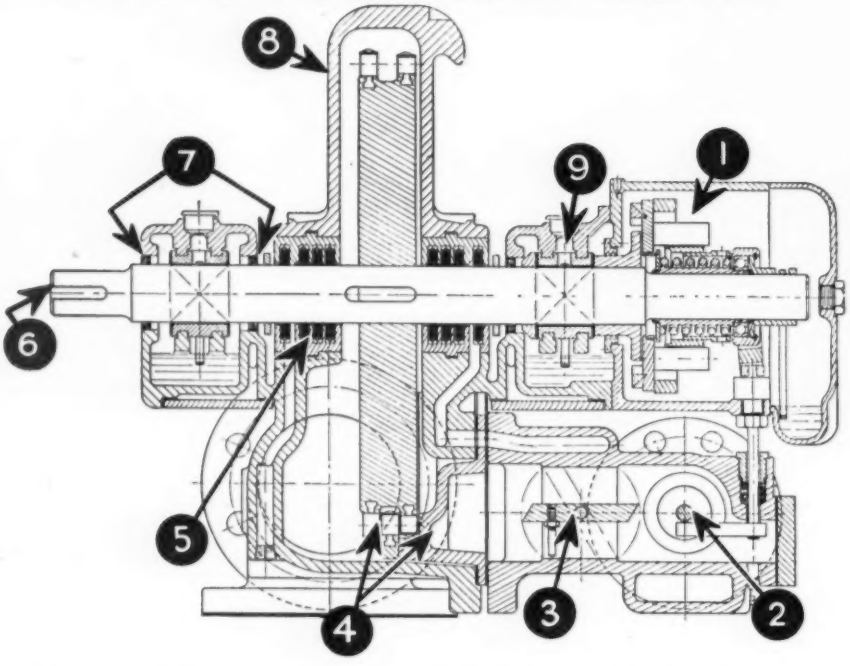
AGENTS IN PRINCIPAL CITIES

PACKLESS CORRUGATED EXPANSION JOINTS



MURRAY *TYPE-S*

SINGLE STAGE TURBINES FOR MECHANICAL DRIVE



1. Mechanical constant speed governor completely enclosed and fully lubricated. Heavy cast housing, removable for inspection. Provision for tachometer reading, by removing end plug.
2. Double seated balanced stainless steel governor valve, with stainless steel renewable seats. Corrosion resisting steam strainer ahead of control valves.
3. Separate emergency overspeed butterfly trip valve actuated by unbalanced weight type emergency overspeed governor.
4. Stainless steel blading and shroud band. Nozzles drilled and reamed in replaceable nozzle ring.
5. Carbon ring glands, stainless steel springs, corrosion resisting gland cases. Cast in leakoff reduces pipe fittings necessary.
6. Tapped hole in shaft end facilitates drawing on coupling.
7. Bearing seals effectively retain oil and exclude dirt and moisture.
8. Casing split at centerline allowing inspection without disturbing alignment or steam connections.
9. Sleeve type babbitt lined bearings with split oil rings, easily removable. Babbitt thrust faces against collars. Inspection covers and flush level glasses included. Water cooling always furnished.

FOR DEPENDABILITY, SPECIFY A MURRAY TURBINE

Bulletin T-121 gives complete details. Write for your copy today.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

23 VACUUM CLEANER—Spencer Turbine Co, Hartford 6, Conn. 4-page bulletin No. 112D announces a new 1½-hp industrial portable vacuum cleaner. Specifications are covered.

24 STEEL SASH—Hope's Windows, Inc, Jamestown, N. Y. 32-page catalog No. 76B gives design and construction features of Lok'd Bar steel factory sash. Dimensions and physical data are shown by full-scale diagrams.

MATERIALS HANDLING

25 DOUBLE-GAP MAGNETS — Dings Magnetic Separator Co, 4740 W McGeogh Ave, Milwaukee 14, Wis. 12-page catalog No. 301-A describes rectangular double-gap electro-magnetic, suspended, spout and plate magnets and wet type magnets for submerged installations. The magnets are for removal of tramp iron to protect equipment, such as crushers, grinders, screens, etc.

26 CONVEYOR BELTING—Hewitt Rubber Div, Hewitt-Robins Inc, 240 Kensington Ave, Buffalo 5, N. Y. Folder stresses the "job-engineered" features of Maltese Cross conveyor belting.

27 MAGNETIC SEPARATORS — Eriez Mfg Co, 2987 E 12th St, Erie, Pa.— 4-page bulletin No. 102-B, entitled "Blueprint for Tramp Iron Removal," discusses Eriez non-electric permanent magnetic separators. Pertinent data and engineering drawings show size, weight and construction of units.

28 BELT CONVEYORS — Jeffrey Mfg Co, Columbus 16, Ohio. In addition to complete data on belt idlers, 160-page catalog No. 785 features standardized units for easy selection of belt conveyors, as well as complete information for calculating horsepower, capacities, speeds and other factors required for designing and laying out belt conveyors for the more complex requirements.

29 MAGNETIC PULLEY — Dings Magnetic Separator Co, 4740 W McGeogh Ave, Milwaukee 14, Wis. 6-page catalog No. 260-A describes the new Perma-Pulley, a permanent Alnico magnetic head pulley for belt-conveyor systems.

MECHANICAL TRANSMISSION

30 V-BELT SHEAVES—American Gear & Mfg Co, 5900 Ogden Ave, Chicago 50, Ill. 16-page bulletin No. 305 shows all necessary dimensions and costs to enable you to apply White-Line standard sheaves to your product or specific power-transmission problem.

31 WORM GEARING—De Laval Steam Turbine Co, Trenton 2, N. J. 48-page bulletin No. WG1220-5-46 gives advantages of worm gearing, bearing load formulae, selection practice, horsepower ratings, worm thread and gear tooth data for different ratios, dimensions and details of standard worm mountings, worm dimensions, gear dimensions and dimensions of standard flanged rims.

32 SHEAVES AND PINS—Tool Steel Gear & Pinion Co, Cincinnati 16, Ohio. 4-page bulletin No. 947 presents Tool Steel Process sheaves and pins. Photographs are included.

33 VARIABLE-SPEED HYDRAULIC TRANSMISSION—Vickers Inc, 1400 Oakman Blvd, Detroit 32, Mich. Bulletin No. 47-40 covers features of Series TR2-*R13F13 variable-speed hydraulic transmission. Speeds and dimensions are given.

34 V-BELT DRIVE — Allis-Chalmers Mfg Co, Milwaukee, Wis. 144-page catalog No. 20B6956 on pre-engineered stock Texrope drives simplifies drive selection so that persons untrained in V-belt engineering can readily specify proper drives. These drives are for all applications from one to 150 hp.

PIPING, FITTINGS, VALVES AND SPECIALTIES

35 CONTROL VALVES — Foxboro Co, Foxboro, Mass. 36-page bulletin No. 277-2 gives various identifying enamel finishes offered on Stabiliflo valves, plates and tables of specifications for control valves, needle valves, poppet valves and butterfly valves. This bulletin has sep-

The owners of this water cooling tower formerly believed raw redwood was the only material able to withstand the moisture conditions. Apac has proved superior both in efficiency and appearance.

K&M "Century" APAC

ASBESTOS-CEMENT SHEETS

A FEW OF THE MANY WAYS APAC SHEATHING CAN HELP YOU

- **Exterior siding**
- **Interior sheathing**
- **Office paneling**
- **Partitions**
- **Linings for elevator casings**
- **Shower stalls**

You've known for years that asbestos-cement is a highly fire-resistant combination. But here's a case where asbestos-cement sheets were used to combat an enemy of exactly the opposite type—the corrosive effects of moisture.

The paneling on this water cooling tower is K&M "Century" Apac—a flat asbestos-cement building sheet that has as many uses as a building has surfaces. Apac won't rot, won't rust, and actually grows tougher with age. It never needs protective painting or other upkeep.

Apac is furnished in thicknesses of 3/16", 1/4" and 3/8". Standard sheet is 4' x 8'. And it's easy to cut—just score and snap off. Nails or screws hold it firmly in place. These advantages, plus surprisingly low cost, make "Century" Apac an unusually economical material. Write us for full details about K&M "Century" Apac—we'll attend to your inquiry promptly.

Nature made Asbestos...
Keasbey & Mattison
has made it serve
mankind since 1873.

K&M best in asbestos ®

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For { LOWER COST... MORE EFFICIENT PUMPING

specify SIER-BATH ROTARY PUMPS

SIER-BATH SCREW PUMP

Advantages: • pulseless flow • anti-friction bearings • vibrationless operation • low maintenance cost • rugged construction.

Pumps: Acetate, asphalts, brines, Bunker C Fuel Oil, cellulosics, greases, molasses, syrups, lube oils, etc.

SIER-BATH GEAREX PUMP

Balanced Axial Thrust • Pulseless Flow • Vibrationless Operation • Roller Bushings for Precision Running under load.

Pumps: Oils, Varnishes, Solvents, Molasses, Chemical Solutions.

Capacities: 1-350 g.p.m.

Discharge: 250 p.s.i. for medium or high viscosities. 50 p.s.i. for water.

MADE BY ROTARY PUMP SPECIALISTS

SIER-BATH Screw Pumps and Gearex Pumps are made in a plant keyed to precision methods of gear manufacturing. Our engineers have a long background of experience specializing in the design of rotary pumps. As a result, the high quality of these pumps enables them to operate for long periods without maintenance. Their pulseless flow and vibrationless operation mean less wear on valves, couplings and other fittings. Pipes and joints remain tight. In every way, the Sier-Bath Screw and Gearex Pumps are constructed to render reliable and continuous service, with least possible maintenance. Write for detailed information.

ALSO MAKERS OF SIER-BATH PRECISION GEARS

FOUNDED 1905 MEMBER A. G. M. A.

Sier-Bath GEAR and PUMP CO., Inc.

9254 HUDSON BOULEVARD • NORTH BERGEN, NEW JERSEY

arate sections on the Vernier Valvactor for high-accuracy positioning of valve plungers, and on air switches and sub-panels for remote valve control.

36 **PROPANE-BUTANE HOSE**—Hewitt Rubber Div, Hewitt-Robins Inc, 240 Kensington Ave, Buffalo 5, N. Y. Folder stresses suitability of Monarch propane-butane hose for handling highly volatile petroleum gases in liquefied form.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ **NICKEL TUBING** — Superior Tube Co, 2183 Germantown Ave, Norristown, Pa. 16-page catalog section No. 10 gives complete and specific information on nickel and nickel alloys as applied to small tubing in both welded and drawn form.

37 **METAL-TUBING CIRCUITS** — Parker Appliance Co, 17325 Euclid Ave, Cleveland 12, Ohio. 76-page handbook No. 111 discusses selection, sizing layout and installation of metal-tubing circuits.

PRIME MOVERS AND ACCESSORIES

38 **DIESEL OIL FILTERS**—Purolator Products, Inc, Newark 2, N. J. 16-page catalog contains scaled diagrams of many oil filters made by Purolator for diesel-engine applications. The description page for each filter also includes a detailed specification chart giving all necessary technical information on construction, dimensions, capacity, weight, etc.

39 **DIESEL ENGINES**—Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y. 4-page booklet, Form No. 10311, presents the new Type SS turbocharged diesel engines. These engines are built in three sizes: six cylinder, 675 hp; seven cylinder, 785 hp; and eight cylinder, 900 hp.

40 **MULTI-FUEL ENGINES** — White-Roth Machine Corp, Lorain, Ohio. Page gives general specifications and dimensions of Type L 2-cycle, horizontal, multi-fuel, heavy-duty engines.

PUMPS

41 **HYDRAULIC PUMPS** — Hydro-Power, Belmont and Sheridan Ave, Springfield, Ohio. 4-page bulletin No. 471 describes a complete line of radial piston-type hydraulic pumps supplying pressures up to 3000 psi. Single sheet covers dimensions of these pumps.

42 **SCREW PUMPS**—Sier-Bath Gear & Pump Co, North Bergen, N. J. 20-page catalog presents full descriptions, capacities and uses of Sier-Bath screw pumps.

43 **VARIABLE-DELIVERY FEED PUMP**—Oilgear Co, 1384 W Bruce St, Milwaukee 4, Wis. 8-page bulletin No. 44200 describes the new Oilgear fluid-power variable-delivery feed pump. Photos, diagrams and tables are included.

44 **CENTRIFUGAL PUMP** — Peerless Pump Div, Food Machinery Corp, 301 W Ave 26, Los Angeles 31, Calif. 4-page bulletin No. D-2400 discusses Type ACO acid and caustic pump. This pump handles capacities up to 600 gpm against heads up to 200 ft.

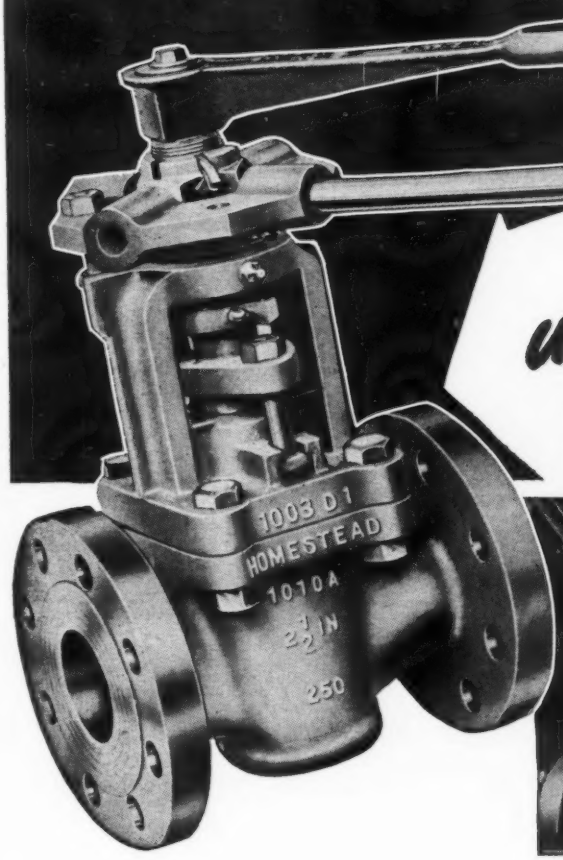
OTHER EQUIPMENT

45 **AFTERCOOLERS** — Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y. 16-page bulletin, Form No. 3014-B, covers benefits, principles and applications of aftercooling. This bulletin gives a complete description of a line of Type PL and M aftercoolers.

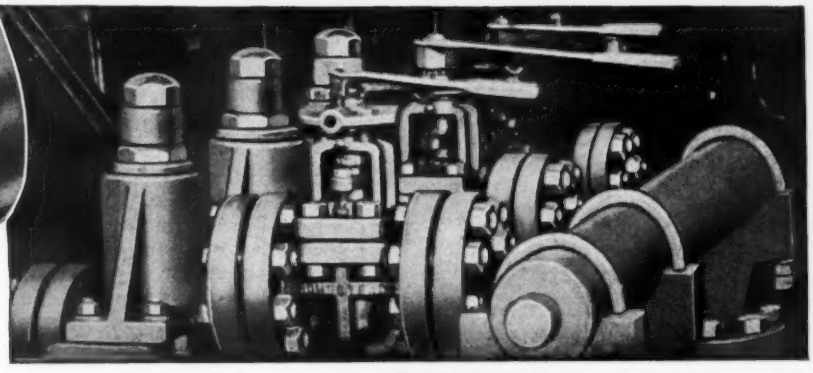
46 **TESTING AND MEASURING EQUIPMENT**—Apparatus Dept, General Electric Co, Schenectady 5, N. Y. 44-page catalog gives information on more than 90 modern equipments for specialized testing and measuring.

For Never-Failing STICK-PROOF Operation

in Services Involving Extreme Temperatures, Pressures and Corrosive Fluids



use HOMESTEAD LEVER-SEALD VALVES



For more than 15 years HOMESTEAD LEVER-SEALD VALVES have solved the operating difficulties of hundreds of manufacturers in services where temperature extremes, pressure and the corrosive action of line fluids would cause ordinary valves to stick or "seize."

HOMESTEAD LEVER-SEALD VALVES *never* stick. For built into each valve is a powerful lever and screw device which relieves seating pressure between plug and body just enough to overcome friction and permit *easy turning at all times and under all conditions.*

They operate *faster* too . . . 16 to 28 times faster than screw-stem-type valves, because a QUARTER-TURN *fully opens or closes* them. The QUARTER-TURN principle also makes them ideal for installation in restricted areas, next to walls, floors, ceilings, congested piping and other obstructions where many other types of valves could not be operated.

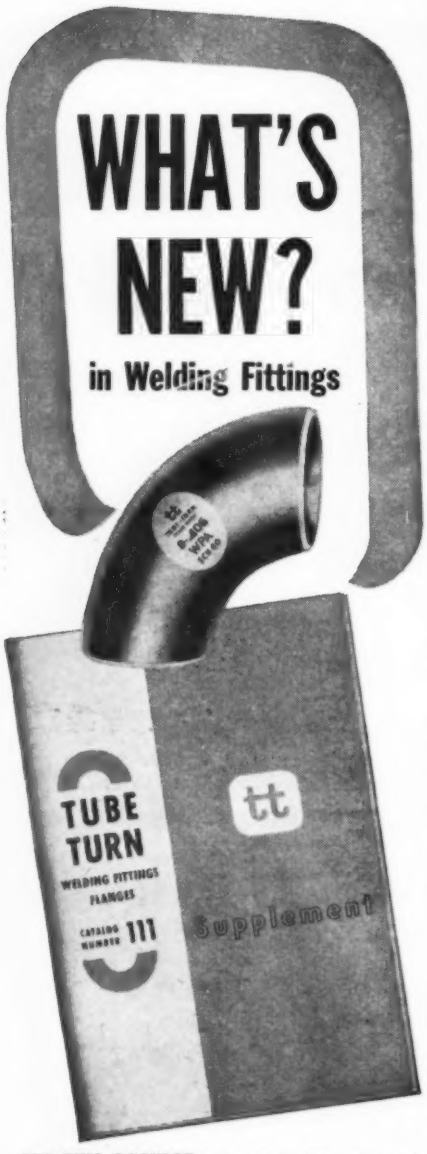
HOMESTEAD LEVER-SEALD VALVES are available in combinations of metals and alloys to meet *your* service requirements. Sizes range from 1½" to 10" for pressures from vacuum to 1500 pounds. For complete details write for Valve Reference Book No. 38. No obligation.

CHECK THESE OUTSTANDING FEATURES

- **A QUARTER-TURN fully opens or closes valve.**
- **INSTANT STICKPROOF OPERATION. Plug turns freely after seating pressure is relieved by screw lever.**
- **LEAK PROOF. Deep stuffing box and gland prevent leakage.**
- **POSITIVE LEAKLESS SEAL WITHOUT USE OF LUBRICANT is obtained by reapplying full seating pressure with screw lever after opening or closing.**
- **STRAIGHT-LINE FLUID FLOW. No obstructions to cause pressure drop.**
- **SEATING SURFACES ALWAYS PROTECTED in both open and closed positions. Fluid or grit cannot damage valve seat.**
- **SEALED BOTTOM prevents fluid loss and reduces hazards.**

HOMESTEAD VALVE MANUFACTURING COMPANY

P. O. BOX 210 CORAOPOLIS, PA.



GET THIS BOOKLET—The Tube-Turn line of welding fittings is BIG, and still growing! This 20-page Supplement to TT Catalog No. 111 gives you data about important new items which, more than ever, make Tube Turns your *one source of supply for all welding fitting requirements.*

TUBE-TURN

WELDING FITTINGS AND FLANGES

TUBE-TURN—*T. M. Reg. U. S. Pat. Off.*

District Offices at New York, Philadelphia, Pittsburgh, Detroit, Chicago, Houston, Tulsa, San Francisco, Los Angeles

Tube Turns, Inc., Dept. 4201
Louisville 1, Kentucky

Please send me a copy of Tube-Turn Catalog No. 111 Supplement.

Name.....

Position.....

Firm Name.....

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Street.....

City.....*Zone*....*State*.....

47 MICRO-GAS ANALYZER — Davis Emergency Equipment Co, 45 Halleck St, Newark 4, N. J. Technical bulletin No. 1143 describes the new Davis micro-gas analyzer for the determination and analyzation of gases or vapors within their toxic range.

48 INDOOR, OUTDOOR THERMOMETER—Jas P Marsh Corp, 2073 Southport Ave, Chicago 14, Ill. 6-page leaflet discusses Marsh Duo-Temp thermometer for registering both indoor and outdoor temperatures.

49 SAND FILTER—Hardinge Co, York, Pa. 12-page bulletin No. 46 covers the Hardinge automatic backwash rapid sand filter for purifying industrial water supplies, sewage treatment, trade waste recovery, municipal water treatment, etc.

50 RESEARCH LABORATORIES — Cook Research Laboratories, 1457 Diversey Parkway, Chicago 14, Ill. 34-page brochure gives objectives, personnel and facilities of Cook Research Laboratories, a division of Cook Electric Co. These laboratories are available to help government agencies and private industry prepare for widespread distribution of scientifically engineered products.

Appointments

(*Continued from page* 168)

Martin has been made manager of central district of Sturtevant div, with offices in Pittsburgh. He replaces Harold C Hickock who has resigned. W G Miller has been made assistant to works manager of Buffalo divisions.

McQuay, Inc, has named C T Bappler as its sales manager for eastern div, with offices at 122 E 42nd St, New York City.

Link-Belt Co has established its own sales office in Grand Rapids, Mich., at 48 Division St, North, to serve customers in western portion of lower peninsula of Mich. Peter Groustra has been named district sales manager in charge of the new office. Herbert E Wolf will assist Groustra. Schloss & Shubart have been appointed stock-carrying distributors, in addition to continuing as Link-Belt sales representatives. Schloss & Shubart have moved to 1626 Wazee St, Denver 2.

Two promotions have been announced by welding fittings div of **Tube Turns, Inc:** Norton P Bosemer has been placed in charge of Los Angeles office at 1489 Washington Blvd, and Robert S Tyler Jr has been placed in charge of a newly established Mid-Continent district, at 311 Tuloma Bldg, Tulsa.

S H Blackwood is now with the New York office of **Wm Powell Co,** at 50 Church St, New York City. T J Malone is also at New York office.

Hagan Corp has transferred Gerald G Lipke from Denver to Hagen-Hall-Calgon staff at Pittsburgh and has also assigned Robert L Handison to sales. Herbert J Kettler has been transferred to St. Louis to assist J C McFarland, manager of firm's St. Louis office. United Engrg Co, 6940 N Olin St, Portland, Ore., has been appointed Oregon representative for all Hagan engineering services and products, and those of its associated companies—Hall Labora-

EXTRA SERVICE

"STANDCO"

PILLOW BLOCKS

There's Extra Value in these rugged well-designed "Standco" Pillow Blocks with their life-long, trouble-free service.

They are fully able to "take it," and have babbitted, accurately broached bearing surfaces, with faces machined to a "T". Easy to clean, easy to lubricate.

Write for Bulletin.

"Usbrako" and "Hallowell" Products are sold entirely through Industrial Distributors

Over 44 Years in Business

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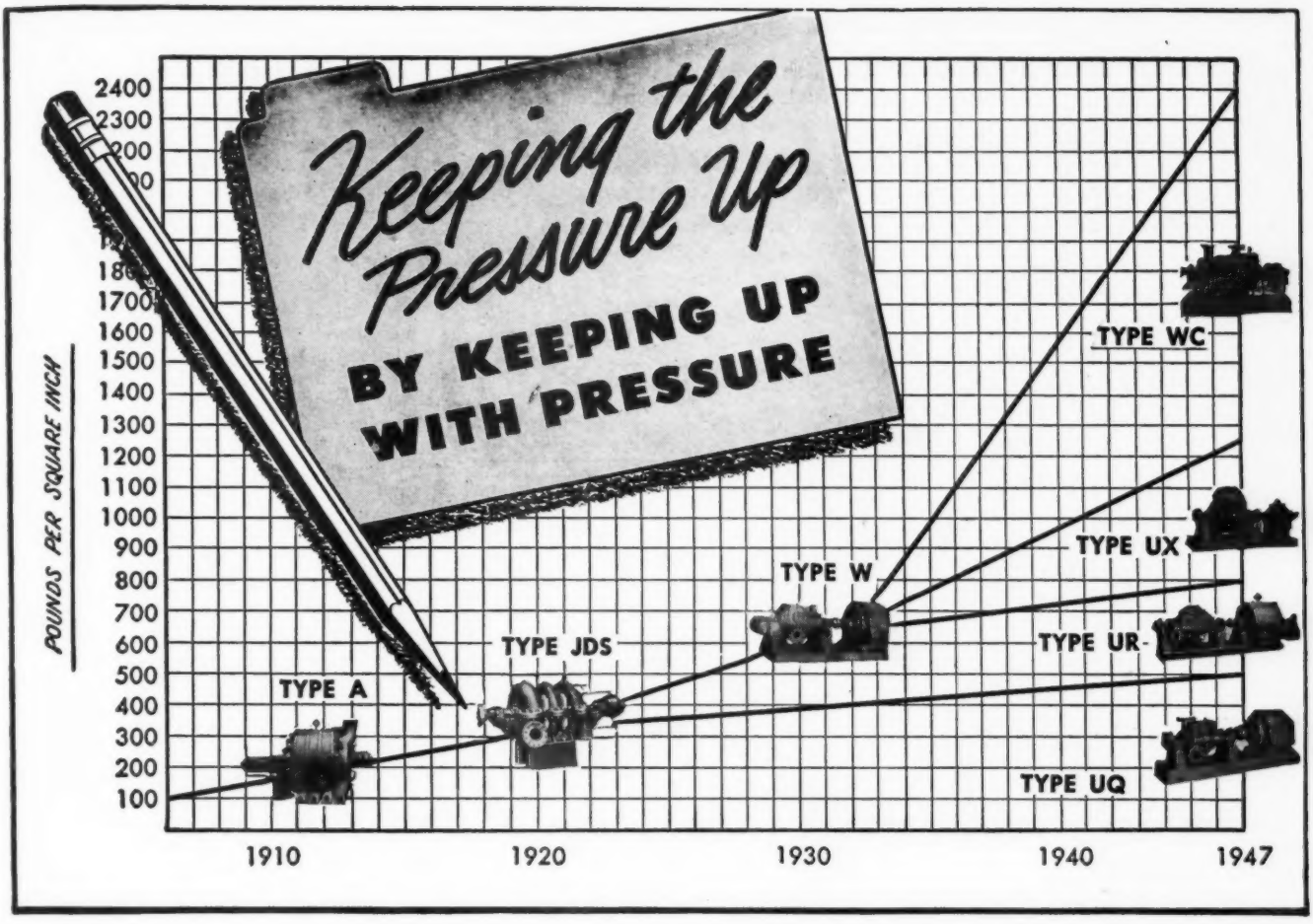
THE *PUMP* WITHOUT PISTONS, VALVES, BEARINGS, GEARS OR VANES

IMO

The IMO pump has only three moving parts—a power rotor and two sealing rotors — nothing to get out of order or to require adjustment. The IMO pump can be depended upon in hydraulic service, governor service, lubrication service and other applications in which continuity of operation and freedom from maintenance are vital.

For further information send for catalog 1-131-P.

IMO PUMP DIVISION of the
DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY



The graph shows you how closely Worthington has kept pace with industry's demands through the years . . . by developing centrifugal pumps to handle steadily mounting boiler feed pressures.

It's a record of steady progress . . . from the old Type A, a great performer at 200 psi . . . to the powerful modern Types WC, UX, UR and UQ, with pressures ranging from 2½ to 12 times the 1910 "ceiling".

THE LONGEST AND BROADEST EXPERIENCE

In addition, out of Worthington's more than 100 years of pioneering in pump design and manufacture have come such notable improvements as the Elastic Seal Ring for tight interstage joints in axially split-case pumps . . . the Metal-to-Metal Ring Type Joint in solid-case barrel pumps.

FOR YOUR OWN BOILER FEED REQUIREMENTS

Worthington has the most complete line of centrifugal pumps — all pressures, all capacities — and engineers trained to fit feed pump to feed cycle for maximum economy and dependability.

For details that prove *there's more worth in Worthington*, contact our nearest District Office. Or write to *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.*

MEMBER

WORTHINGTON

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THE WORLD'S LARGEST MANUFACTURER OF PUMPS

For Boiler Feed Service	For Hotwell, Condensate, Chilled Water Service	For Boiler Feed Service	For Water Works, Circulation, Drainage, General Service	For Boiler Feed Service	For Boiler Feed Service
Capacities to 1500 GPM	Capacities to 1400 GPM	Capacities to 1500 GPM	Capacities to 135,000 GPM	Capacities to 1600 GPM	Capacities to 3000 GPM
Heads to 1000 Ft.	Heads to 650 Feet	Heads to 1600 Feet	Heads to 400 Feet	Heads to 3500 Feet	Heads to 7000 Feet

Extra STRENGTH for Heavy Duty

KEWANEE

• Extra stout stays and braces add further strength to the sturdy steel construction.

10 to 304 H. P.

100, 125, 150 lbs. W. P.

Has all the characteristics which make firebox boilers especially adapted for high pressure.

WON FOR 8th TIME

75 Years Boilermakers

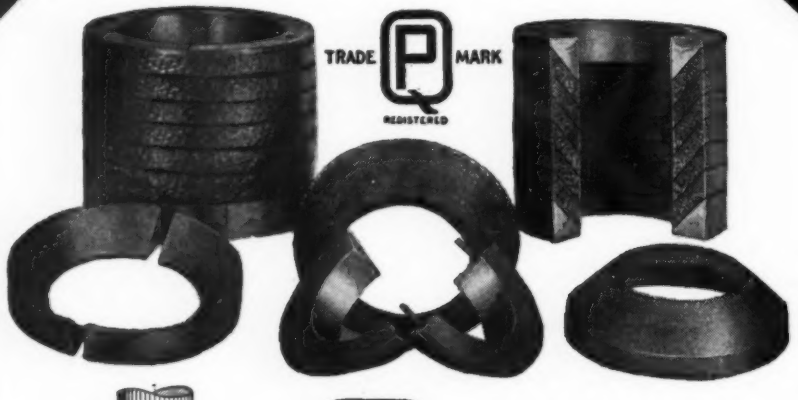
For 6" scale with pipe diameter markings... WRITE Dept. 96-K1

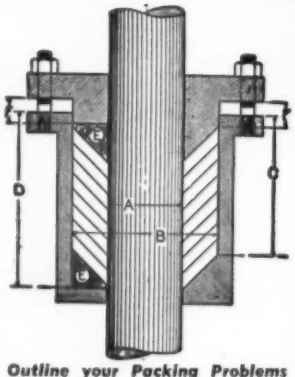
KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS

Diesel Engines

A SPECIAL SECTION

In its April issue, POWER will commemorate the 50th Anniversary of the American diesel engine with a comprehensive survey of modern engines. Watch For It!





Outline your Packing Problems and Let us show you what "Q-P" Self Setting Packing can do for you.

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PACKING

Q-P Self-Setting Packing has demonstrated its superiority under the most difficult conditions on land and sea and can be depended on to meet requirements for high maintenance economy. It is the ideal packing for superheated steam, saturated steam, hot and cold water, ammonia, fuel oil, compressed air, gases and acids and other operating conditions. (For Valves, Turbines, Diesels, Expansion Joints, Hydraulic Equipment, etc.).

THE Q-P MANUFACTURING COMPANY
NEEDHAM HEIGHTS 94, MASS.

Sales Representatives in Leading Cities from Coast to Coast

tories, Calgon, Inc, and Buromin Co. J Rodger Sheridan is president of the newly organized United Engrg Co. Hagan has appointed Maintenance Engrg Corp, Houston, Tex., to represent it in Mexico. Maintenance Engrg Corp has in turn established offices at Av Morelos 42-H, Mexico, D. F., and named Guillermo Almazan as its resident engineer.

W C Bennett has been named district engineer for **Hall Laboratories** for the area comprising Colo., western Tex., Utah, N. M., and Wyo. He will make his headquarters in Denver with Denver Fire Clay Co, which represents the parent firm, Hagan Corp, and its associated companies. Bennett succeeds Gerald G Lipke, who has been transferred to Pittsburgh sales area.

Springfield Boiler Co, Springfield, Ill., announces completion of negotiations in which Gustav A Rehm becomes chief engineer for the Springfield organization and head of all engineering activities in connection with steam generators and related equipment. As chief engineer Rehm succeeds W Ross Irwin, who has recently engaged in a private engineering practice with headquarters in Springfield, Ill., P O Box 178. Irwin continues to be available to the company as a consultant and is specializing in supervision of steam-plant operation for clients located in the Middle West.

Nagle Pumps has appointed Charles L Edwards chief engineer.

Jack H Gill has been made engine sales consultant for **Caterpillar Tractor Co.** In his new capacity, Gill will advise, coordinate and plan development of engine sales with sales managers at main offices in Peoria, Ill.

Anthony J Zino Jr has been made assistant sales manager of industrial sales div of **Swan-Finch Oil Corp,** with headquarters in home office, R C A Bldg, New York City.

Brooks Boiler Treatment Co, 3304 E 87th St, Cleveland, Ohio, has elected Lawrence W Brennan president. Other officers elected at the board meeting are Fred J Mack, vice-president; Alfred B Garson, secretary-treasurer (re-elected); and Larry D Brennan, sales manager.

Charles E McGlaughlin has joined headquarters staff of **Bituminous Coal Research, Inc,** as special representative to maintain contact with BCR members, coal producers, railroads and manufacturers of coal-burning equipment. He succeeds T A Day, who became a member of public relations staff of Bituminous Coal Institute, an affiliated organization.

C F Jensky has been made general sales manager of **Besler Corp.** Jensky will devote his full time to steam generator and pump divisions of the corp.

Oil purifier div of **Hilliard Corp** has named new representatives to handle line of Hilco lubricating, fuel and industrial oil-purifying equipment: (1) Hucker Sales Co, 1700 Walnut St, Philadelphia 3, Pa.,

Wash behind the ears, please!

Whether you're cleaning a giant vat or scrubbing a little boy, you must "wash behind the ears."

That means getting into every nook and cranny of the vats, tanks or other equipment in your plant. Or at a golf course, for instance, it means putting plenty of water on every inch of grass.

But look what happens when you do that!

If you have ordinary hose—whether you use it indoors or out—moisture seeps into its carcass. Reinforcing cotton plies rot. The carcass falls apart. Result . . . you have to get another hose.

Then, too, ordinary hose suffers severe cuts and abrasions when you drag it around machinery and equipment or over rough ground. Once more you're out of hose . . . and out of luck.

Way to lick the problem is to use Maltese Cross Water Hose. It's made by Hewitt to resist cuts and abrasions . . . to stand up to the wear that results when you drag it into hard-to-reach spots. In short, this tough, flexible, nonkinking hose is designed to *wash behind the ears!*

Of course, industrial plants and golf courses are only two of hundreds of places where you'll find Maltese Cross Water Hose. Check your florist's greenhouse, your creamery, or dozens of other places where watering or washing enters the picture. Chances are you'll find it hard at work there, too.

Maltese Cross Water Hose is but one example of many Hewitt Rubber developments to meet specific industrial needs. Other products include conveyor, transmission and elevator belting, and steam, acid and welding hose.

For complete details, phone the Hewitt distributor listed in the yellow pages of your phone book. Or write Hewitt Rubber Division, 240 Kensington Ave., Buffalo 5, N. Y.

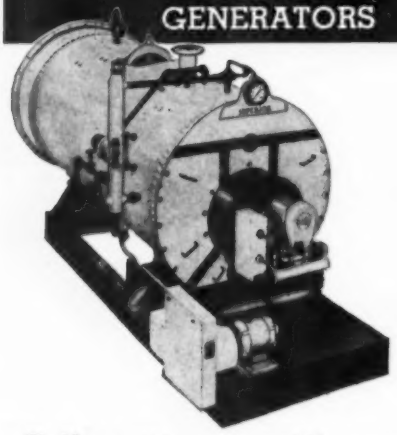
You can depend on your industrial supply specialist

He's always ready to serve you. And he knows your job . . . your operations . . . your problems. Call on him at any time for advice. He'll recommend the exact Hewitt product especially designed to help *improve* the efficiency of your operations.

HEWITT RUBBER
DIVISION
HEWITT-ROBINS INCORPORATED
INDUSTRIAL HOSE • BELTING • PACKING

Maltese Cross Water Hose

SUPERIOR
STEAM GENERATORS



Fully automatic with any grade of oil. 17 sizes from 20 to 500 b.h.p. for pressures up to 200 p.s.i. Require no expensive chimney, supply their own induced draft. 80% thermal efficiency guaranteed. Write today for catalog 101.

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Learn the secret
of BIG EARNINGS in . . . . COMBUSTION ENGINEERING

There are plenty of good pay jobs in the power field today. Increase your earnings now—be a Hays-Trained Combustion Engineer. Just a little of your spare time required for the simple, easy-reading Hays Home Study Course. Hundreds of others have made better jobs for themselves through Hays training. So can YOU.

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to operate in Philadelphia area. (2) R T Whitson & Son, 723 Transportation Bldg, Cincinnati 2, Ohio, to operate in Cincinnati area. (3) L M Sands & Co, 246 Ritch St, San Francisco, Calif., to operate in Calif. (4) R E Chase & Co, Tacoma Bldg, Tacoma 2, Wash., to operate in Wash. and Ore. area.

Auston F McCormack has been named sales engineer in charge of new Rochester, N. Y., office of **Permutit Co.** F D West, formerly in charge of company's Syracuse office which is now closed, has retired after 29 years of service with the company.

Syntron Co announces establishment of a branch sales office in Montreal at 4695 Sherbrooke St, West, under supervision of C F A Gray.

Industrial Sales & Engrg Co, 352 Miners Bank Bldg, Wilkes-Barre, Pa., has been made field engineers and sales representatives for **Ajax Flexible Coupling Co.**

Hammel-Dahl Co, Providence, R. I., has appointed Metrol Co, Detroit, Mich., as its sales representative. The area to be covered is the lower peninsula of Mich. and northwest Ohio.

Hewitt-Robins Inc has named Industrial Supply Co, Minneapolis, Minn., as a distributor of entire Hewitt rubber division's line of industrial hose, belting and packing, covering Minneapolis and St. Paul, Minn., and N. D. and S. D. St. Louis Railway Supply Co, St. Louis, Mo., has been made distributor of Robins conveyors div equipment in general St. Louis area.

Morman Belting & Supply Co, 522 W State St, Milwaukee 3, Wis., has been appointed distributor for **Parker Appliance Co,** Cleveland.

Lynn W Nones has recently assumed his new duties as sales manager of **Diamond Power Specialty Corp,** at home office in Detroit.

Esterline-Angus Co announces appointment of W H Bollinger as exclusive representative for Pittsburgh territory. He will be at P O Box 8088, Pittsburgh 16, Pa. T A Kenny has been made exclusive representative for metropolitan New York area. He can be reached at P O Box 266, Summit, N. J.

Lee H Benson has joined **Tuthill Pump Co** as vice-president in charge of manufacturing.

A T O'Neill has been elected president of **Niagara Falls Power Co,** succeeding the late Paul A Schoellkopf.

Election of G N Martin of Dominion Bridge Co, Ltd, as a trustee of **American Boiler Manufacturers' Association** marks the first occasion on which a Canadian has served on executive committee of the organization.

Lyman B Brainerd has been elected president of **Hartford Steam Boiler Inspection and Insurance Co,** succeeding Cur-

GIANTS
in the world of Water Pumping

Peerless Hydro-Foil MIXED FLOW Pumps

CAPACITIES: UP TO 220,000 G.P.M.
LIFTS: 2 to 60 FEET

Rapidly Move and Remove Vast Volumes of Water Against Low and Medium Heads

Highly successful in the efficient handling of large volumes of water, Peerless Mixed Flow Pumps are being applied to process work, condenser service, liquor and chemical circulation, and a variety of industrial services where pumping is desired from open pits, sumps, and surface water sources, such as lakes, rivers, etc. and for large scale dewatering operations.

Peerless has proved the effectiveness of incorporating aero-dynamic streamlining principles to large-volume water lifting, resulting in new conceptions of high efficiencies and lower overall pumping and maintenance costs.

Water turbulence accompanying the usual propeller and vane construction, and normally resulting in excess wear, inefficiency and loss of power, are reduced to the minimum in the Peerless Mixed Flow design.

Cutaway view of Mixed Flow multi-stage pump impeller and bowl construction revealing high-efficiency impellers utilized for more economical water lift.

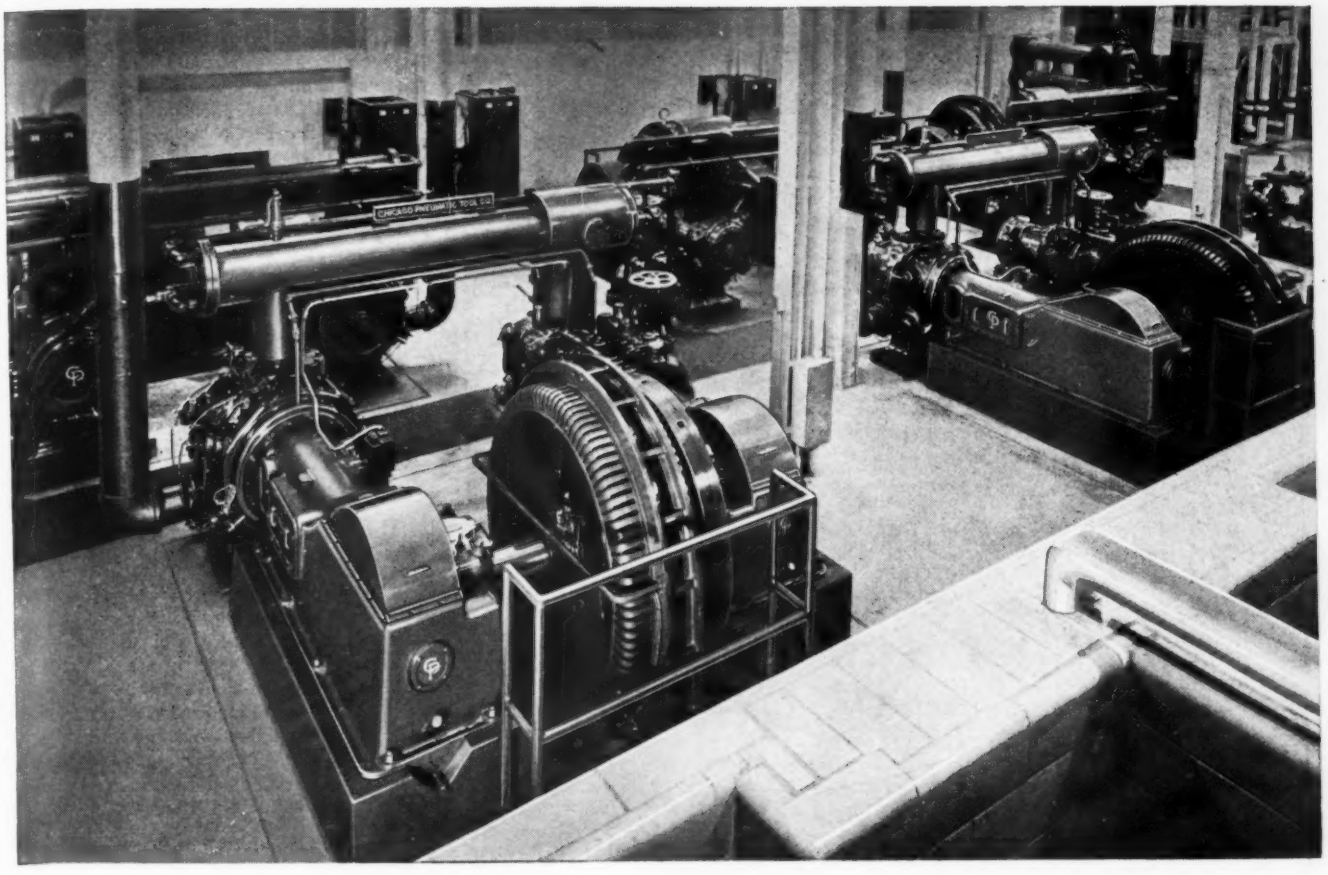
Peerless Propeller Type Pumps

Peerless pumps, embodying the Hydro-Foil principle, are available in the propeller type and are capable of handling identical capacities of the Peerless Mixed Flow pump. Request Bulletin B-148 completely describing the design, construction and application data of these two types of Peerless Pumps, for large-volume water pumping.

fmc PEERLESS PUMP
PEERLESS PUMPS

Peerless Pump Div., Food Machinery Corp.

Factories: Los Angeles 31, Cal.; Quincy, Ill.; Indianapolis, Ind.
District Offices: Chicago 40 Ill., 4554 No. Broadway; Philadelphia Office: Suburban Square, Ardmore Pa.; Atlanta Office: Rutland Bldg., Decatur, Georgia; Dallas, 1, Texas; Fresno, California; Los Angeles 31, California.



for continuous heavy-duty and economical operation

O-CE Compressors

Rugged construction, conservative rating, and low power consumption make the CP motor-driven Class O-CE the ideal compressor for the continuous, heavy-duty job.

- Quick-acting Simplate valves minimize power consumption, and provide high volumetric efficiency.
- Large, streamlined air passages make air flow resistance negligible.
- CP Multi-step Control handles partial load demands with maximum economy.
- CP Intercooler assures maximum heat transfer with low water consumption.
- CP Automatic Starting Unloader completely unloads compressor when starting and stopping.

The CP Class O-CE Compressor is of the horizontal, double-acting, water-cooled type, with direct-mounted synchronous motor drive. Furnished in sizes up to 1,500 h.p., for pressures up to 5,000 pounds. Write for full information.

CHICAGO PNEUMATIC TOOL COMPANY

General Offices: 8 East 44th Street, New York 17, N. Y.

AIR COMPRESSORS • ELECTRIC TOOLS • PNEUMATIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

"THAT'S FOR ME!!!"

That's just exactly what the man said.

You've probably said it, too—as you leafed through the advertising pages of a current issue of THIS magazine.

It happens all the time—to every man who is on top of his job.

Why? Because he keeps a weather eye out for the things that promise a better, faster, more economical way of doing something.

He knows that America's leading manufacturers take the newest and best of their products and services to market in the advertising pages of the business and industrial magazines that help him keep on top of his job. And if *it's for him* he wants to know what makes it tick.

To keep in touch with the parade------

READ THE ADS.

tiss C Gardiner, who has retired on account of ill health. Fred S Campbell has been appointed vice-president in charge of agency dept.

Georgia Power Co has elected Clifford B McManus president, succeeding the late Preston S Arkwright Jr. Dan MacDougald was made chairman of board of directors.

Selvage & Lee, industrial public relations, announces removal of its New York offices to 1 E 43rd St, New York 17, N. Y.

OBITUARIES

Sir Leonard Pearce, 74, engineer-in-chief of London Power Co, Ltd, London, England, for last 21 years, died at his home at Bickley, Kent, on Oct 20. He was responsible for design and construction of new Deptfort West and Battersea power stations, both of which are regarded as outstanding examples of economical operation and as modern expressions of art of electrical generation. Sir Leonard was created a knight in 1935, the honor of commander of the order of the British Empire having been conferred upon him in 1919 in recognition of his services to electrical supply industry during first world war. Honorary membership to American Society of Mechanical Engineers was conferred upon him in 1946.

Ezra F Scattergood, 76, former chief electrical engineer and general manager of Los Angeles bureau of power and light, died Nov 15 of a heart attack.

William A Buttrick, 72, who served as president of Central Vermont Public Service Corp from its organization in 1929 until his retirement in 1936, died suddenly at his home in Concord, Mass., on Nov 21.

Dr Benjamin E Sibley, 73, chief medical officer for Boston Elevated Railway and Metropolitan Transit Authority for over 30 years, died at Brookline, Mass., on Nov 19.

Charles C McCarthy, 73, stationary engineer at Hotel Statler, Buffalo, for more than 15 years, died recently. He was also a stationary engineer for the City Ice & Fuel Co.

Roderick O Richards, 74, an operating engineer at Wellesley College, died at Natick, Mass., on Nov 21. In his earlier career he was chief engineer of power plant of Boston & Worcester St Railway in Framingham, Mass., before electric traction was superseded on the system by buses.

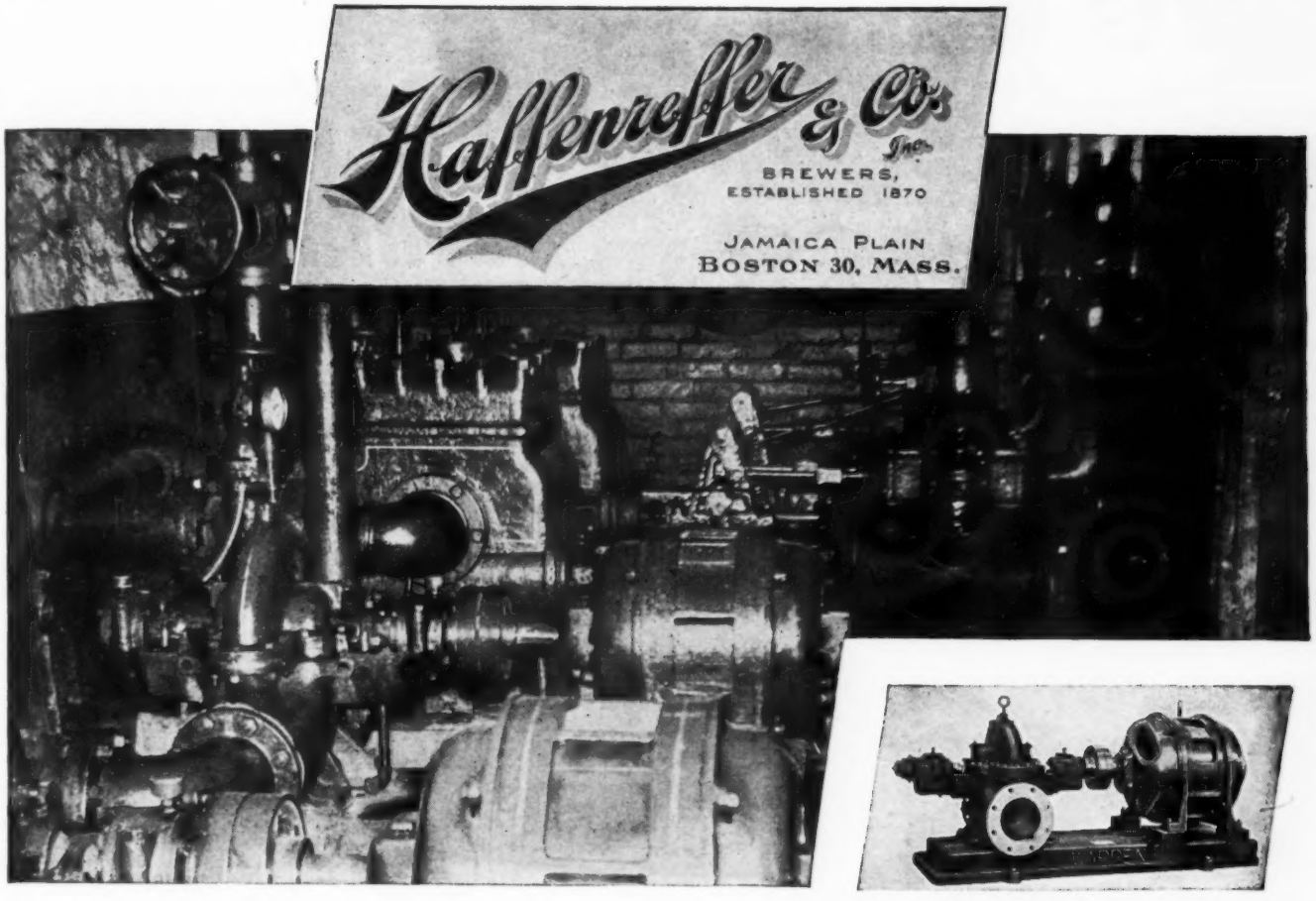
C Ernest Upham, 53, chief engineer of Walter Baker & Co, div of General Foods Co, Dorchester, Mass., died at Milton, Mass., on Nov 13.

Joseph I Tupper, 67, retired chief engineer of Malden (Mass.) High School, died in that city on Oct 30, following a fall.

John W Dinsmore, 71, chief engineer at Lafayette High School, Buffalo, died recently at his home after an illness of about 18 months.

Frank E Ott, 70, a retired stationary engineer, died recently at his home in Buffalo after an illness of more than a year. Before his retirement four years ago, he had been engineer at the YMCA for seven years.

Another famous user of WARREN PUMPS!

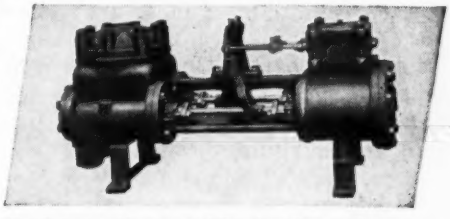


Haffenreffer and Co., brewers in Boston since 1870, depend on Warren Centrifugal and Reciprocating Pumps for efficient, low-cost, long-life pump performance, just as many breweries and widely varied industries have depended on Warren Pumps for the past half century.

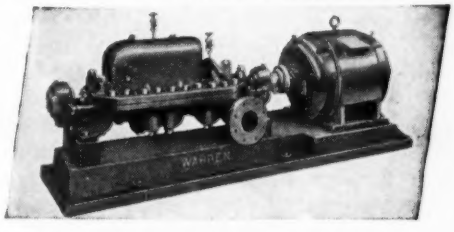
For 50 years Warren engineers have designed and built pumps that have solved the pumping problems of hundreds of plants. If you have a pump problem we invite you to write us, letting us have as much detailed information as possible. Our engineers will be glad to make recommendations, with no obligation on your part.

Warren Steam Pump Company, Inc.
WARREN, MASSACHUSETTS P-8

Warren DM and DL, Single Stage, double-suction centrifugal pumps are widely used on various general services. Special metals, capacities, heads, etc., are available to meet various operating conditions.

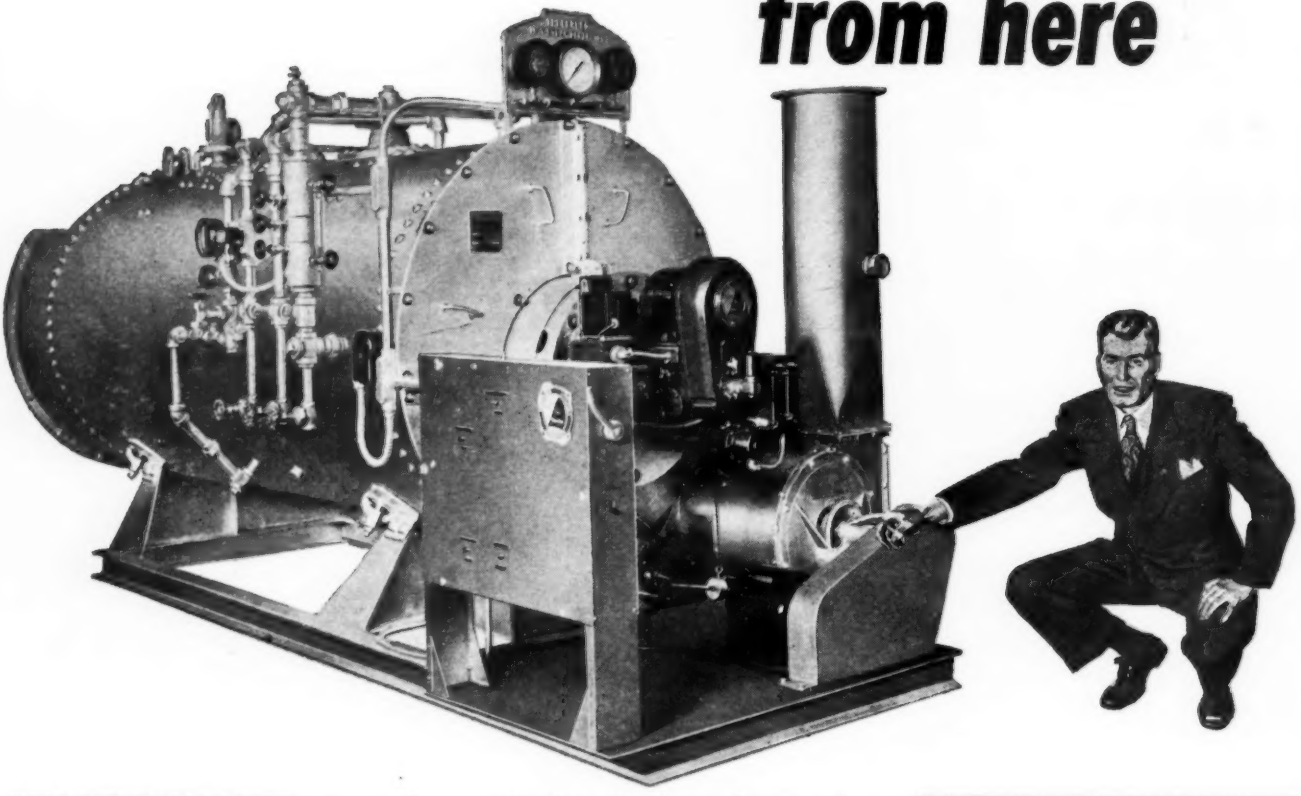


"Realwear" Horizontal Duplex Piston Pumps—a favorite for boiler feed, fuel oil pressure, oil transfer, general water services, etc. Type TM (below) Four and Six Stage for high pressure requirements in boiler feed, etc.
Write for special bulletins



WARREN PUMPS

WHY....PREFERRED'S DRAFT *is pulled through from here*



PULL-THROUGH DRAFT, pioneered by Preferred, is one of several features which contribute to the extra efficiency, safety, and economical installation of Preferred Unit Steam Generators.

Preferred's Induced Draft *pulls* the hot gases of combustion through the four passes. It completely eliminates the need of erecting an expensive stack . . . assures the exact amount of air for perfect combustion regardless of atmospheric conditions . . . and prevents the products of combustion from being forced into the boiler room.

Induced Draft tends to keep the flue passes clean of the solid products of combustion. A still-air trap permits the solids to drop into a clean-out compartment, from which they may be easily removed.

Air is drawn through ports in the combustion chamber refractory lining, thereby pre-heating the air and cooling the refractory.

The electric motor is smaller . . . the fan quieter . . . because *induced* gas flow is smoother. The air is drawn gently into the combustion chamber, thereby aiding ignition. The burner won't ignite before the fan starts; gas passes are thoroughly purged prior to ignition.

These many benefits of pull-through draft are the result of Preferred's policy of progressive engineering and design improvement . . . a policy of producing the best possible steam generating plant.

Write for your copy of Bulletin 1000-E. It describes in detail the features of the Preferred Unit Steam Generator. Ask also for the revealing, non-advertising booklet, "Dividends from Your Power Plant."

ADDITIONAL FEATURES OF PREFERRED UNIT STEAM GENERATOR

1. Fully Automatic Operation—even with Bunker C or No. 6 oil.
2. Preferred Oil Burner—exclusive aid to perfect combustion, built especially for this unit.
3. Four-pass, Down-Draft Gas Travel—results in maximum heat absorption.
4. 80% Minimum Thermal Efficiency—proved and guaranteed.
5. Low Maintenance—the result of over 27 years of combustion engineering experience.
6. Full Range of Sizes—from 40 to 500 H.P., pressures of 15 to 200 lbs. Two-pass Units in 20 and 30 H.P. and 15 lbs. pressure.

P-1-48

PREFERRED UTILITIES MANUFACTURING CORPORATION, 1860 Broadway, New York 23, N. Y.

PR-139

PREFERRED UTILITIES MFG. CORP.

CHASE VENTILATED BUS CONDUCTOR

For maximum mechanical strength in all directions, nothing can match the square type of bus conductor. This simple one-piece construction of Chase Square Copper Tube also makes it easier to install, since no auxiliary clamping devices are needed.

But Chase engineers didn't stop here. Special ventilating holes in both top and bottom faces of the tube provide internal cooling by natural convection. Thus high current-carrying capacity is combined with great rigidity.

Before deciding upon any new AC bus installations, find out more about Chase Ventilated Bus Conductors...how they save installation time and labor, conserve copper, and stand up to the job efficiently. For information about this and other bus conductor forms, send for the Chase Electrical Handbook. Simply address Dept. PO-18.

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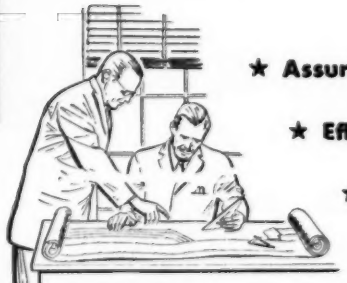
SUBSIDIARY OF KENNECOTT COPPER CORPORATION

THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

ALBANY† ATLANTA† BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DETROIT HOUSTON† INDIANAPOLIS JACKSONVILLE† KANSAS CITY, MO. LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† SAN FRANCISCO SEATTLE ST. LOUIS WASHINGTON† (†Indicates Sales Office Only)

Operating Cost Savings

ENGINEERED INTO PIPING BY NAVCO



- ★ Assured Safety
- ★ Efficient Operation
- ★ Minimum Fuel Costs
- ★ Low Maintenance
- ★ Long Trouble-Free Life

Careful and expert preliminary engineering work by Navco Engineers, in addition to employing the most modern fabricating and erection methods, are your guarantee of operating savings.

Consult Navco for just a Pipe Bend, or a complete Piping System.

NAVCO

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

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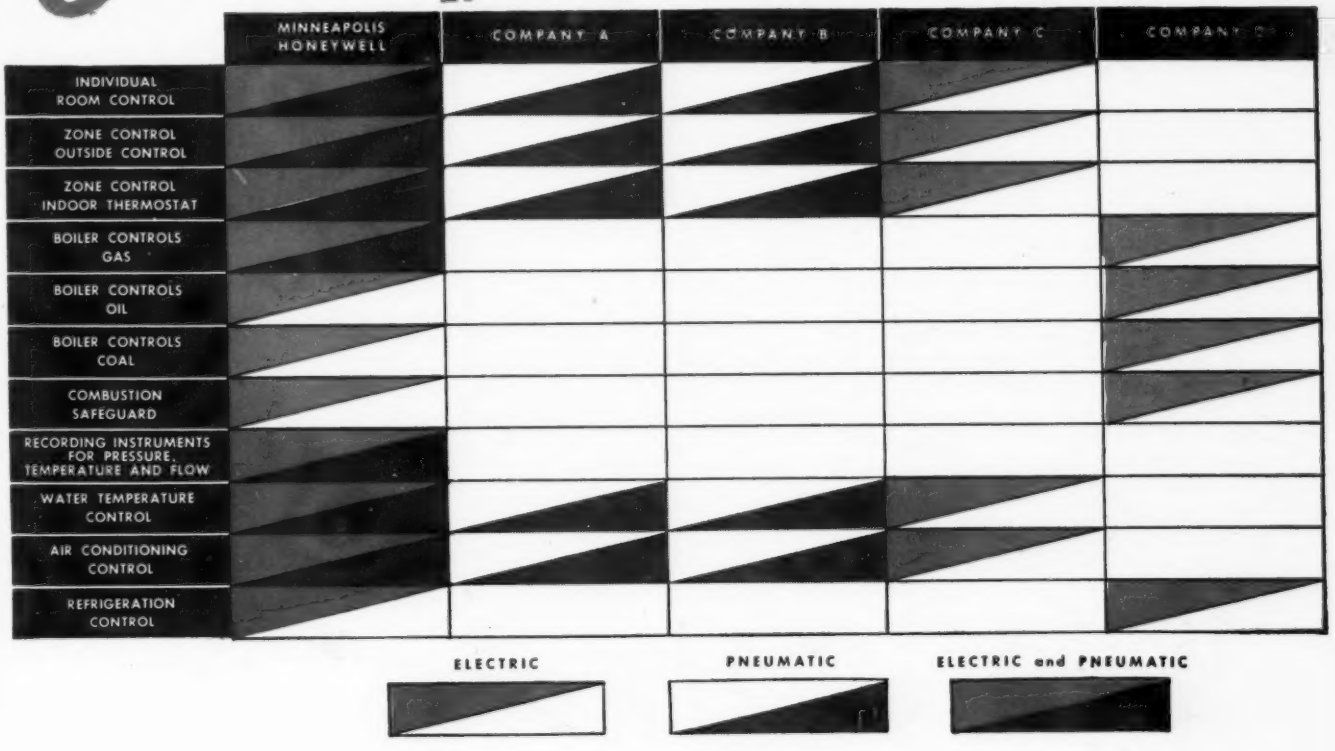
ONLY HONEYWELL gives you

Controls for Every Purpose!



THE chart tells the story! Only Minneapolis-Honeywell can supply a complete line of both electric and pneumatic controls for every factory requirement. Think what this means from your standpoint. All your controls from one manufacturer means uniformity of design and quality . . . and standardization means efficiency. It's the same manufacturer —Minneapolis-Honeywell—who is able to give you unbiased advice, based on broad engineering experience, about every type of control. And Honeywell maintains a nation-wide staff trained to provide service from plan stage throughout the life of every installation, electric or pneumatic.

Backing this comprehensive operation is the Honeywell reputation for dependable performance, established for over 60 years. Benefit by standardizing with Honeywell—the leader . . . Minneapolis-Honeywell, Minneapolis 8, Minnesota . . . In Canada: Toronto 12, Ontario.

MINNEAPOLIS **Honeywell**

CONTROL SYSTEMS

Leak Proof !

The Parker 3-Piece Fitting

HOLDS BEYOND TUBE-BURSTING PRESSURES

Even if used under pressures severe enough to burst the tubing, PARKER *3-Piece* Tube Fittings remain intact . . . and do not leak or distort. Pictured is just one sample from thousands of tests that have been made—all with the same leakproof performance result.

PARKER Tube Fittings control vibration better. They're easy to assemble . . . may be reassembled repeatedly. Shapes are machined from high-strength forgings. Offered in the widest range of shapes and sizes in brass, steel, stainless steel—and aluminum. Two styles—*3-Piece* flare-type and flareless Ferulok. Warehouse stocks conveniently located in all major industrial centers.

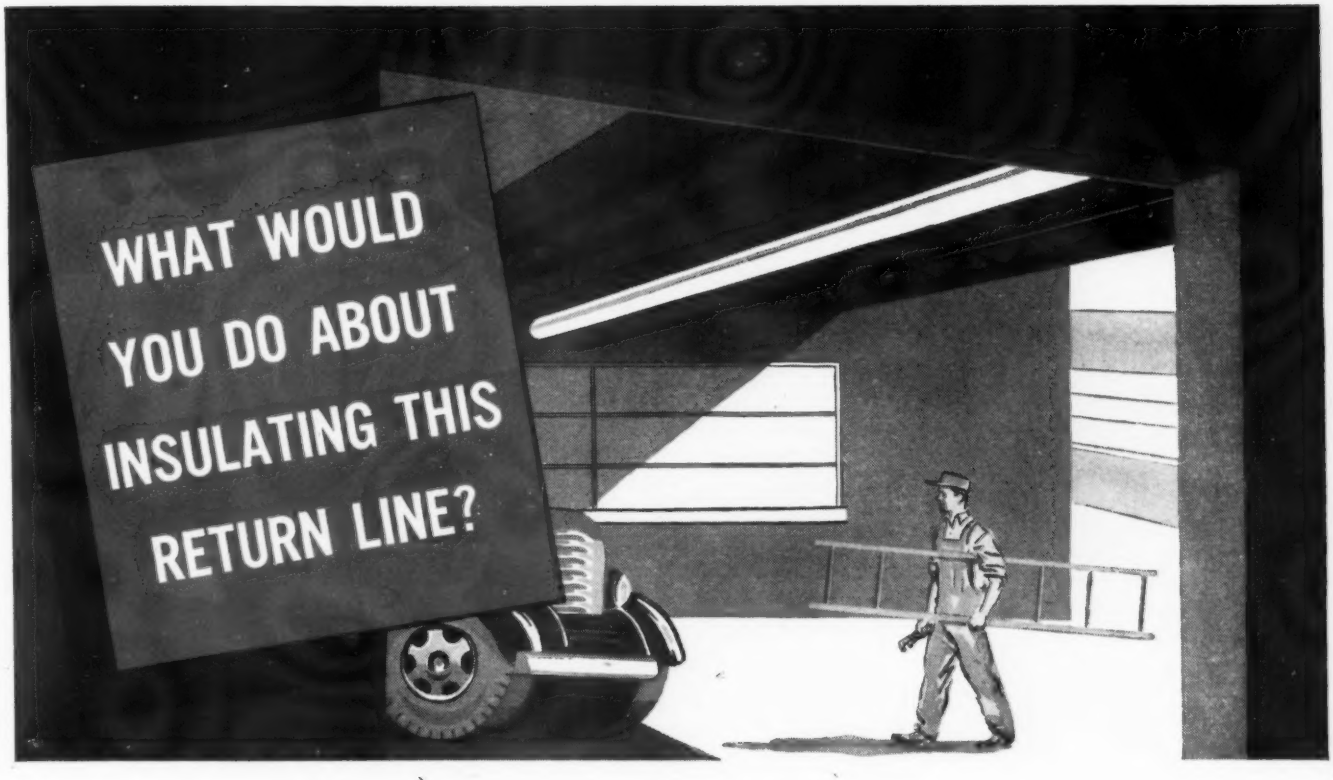
Write today for Fittings Catalog 202, Ferulok Bulletin A-57 . . . and name of nearest distributor.

Parker

TUBE FITTINGS • VALVES

THE PARKER APPLIANCE COMPANY
17325 Euclid Avenue • Cleveland 12, Ohio

Plants: Cleveland and Los Angeles
Offices: New York, Cleveland, Chicago, Los Angeles, Dallas, Atlanta
Distributors in Principal Cities



HERE'S THE PROBLEM: Factory uses steam for processing. Condensate return lines totalling 2,106 feet in length are now uninsulated. Peak loads average 3 hours daily, and the feed water heater can furnish only 80% of recently increased load. This makes steam costly and inadequate for full production. What insulating material, if any, would you apply to these return lines?

☐ None? ☐ Air-cell? ☐ 85% Magnesia?

Here's what the Armstrong Engineer advised:

Leaving the return lines bare is uneconomical in view of increased production and rising fuel costs. Buying an additional feed water heater might solve the problem, but its installation cost would be far greater than that of insulating the lines. Insulation of some kind is definitely needed. But which kind?

Air-cell pipe covering would be adequate if the peak loads were brief and occasional and the return lines short. In this case, the loads are too heavy and the lines too long to make it desirable.

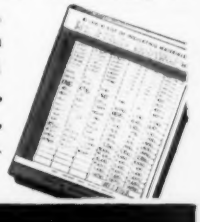
Economical operation here can be attained only with 85% Magnesia pipe covering. The extra cost of this type of insulation will be repaid, under present conditions, within months. 85% Magnesia is recommended for this job.

★ ★ ★

This is one case where it pays to buy the best. But there are plenty of cases where less expensive insulation would be adequate. And the Armstrong engineer will tell you if yours is one of them. Our contract service is not based on giving you the job that makes the most immediate profit for Armstrong, but the job that best fits your needs. That goes for the entire Armstrong setup—supply of materials, workmanship, and supervision, as well as engineering. We think that's the best policy in the long run. That's why it pays to call in the Armstrong man whenever you're planning any kind of heat insulation job.

Free! New Insulation Chart

This chart lists types and thicknesses of insulation for temperatures from 300° below zero to 2800° F. Write today to Armstrong Cork Co., Industrial Insulation Department, 7001 Maple Ave., Lancaster, Pennsylvania.



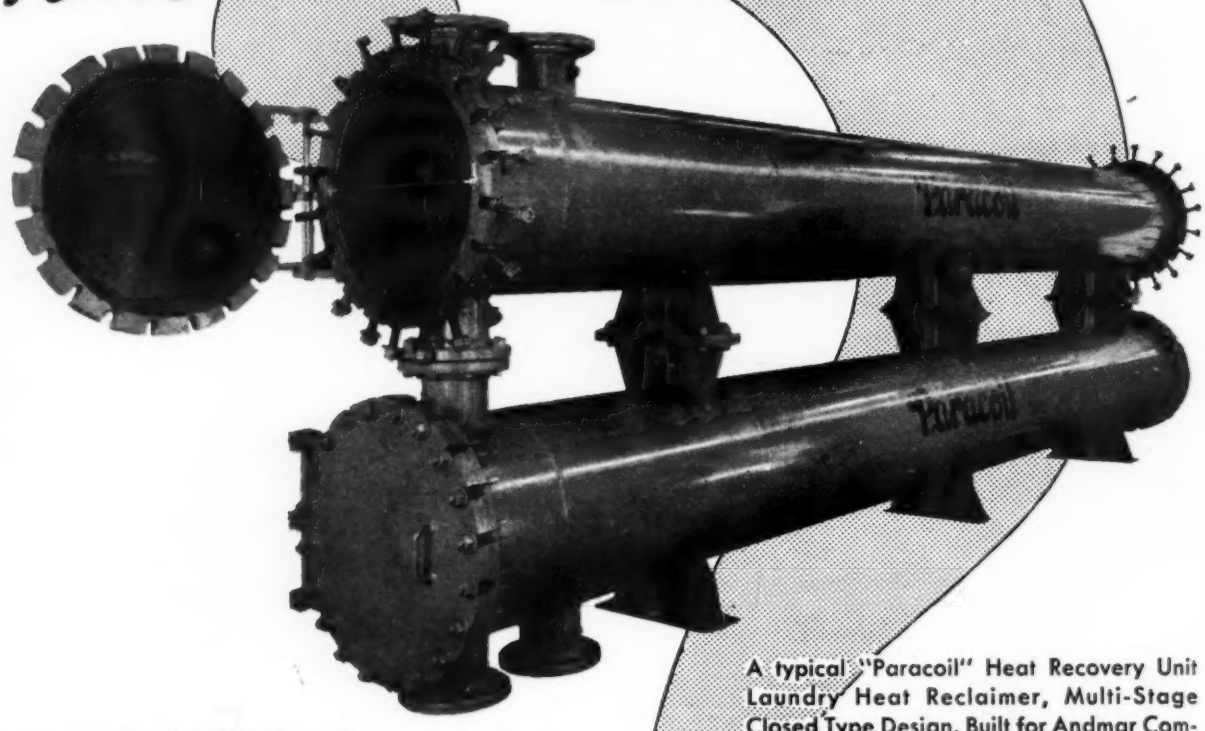
ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service
For All Temperatures

From 300° Below Zero

To 2800° Fahrenheit

What Price B.T.U.



A typical "Paracoil" Heat Recovery Unit Laundry Heat Reclaimer, Multi-Stage Closed Type Design. Built for Andmar Company, Engineers, New York.

Every steam plant in America—regardless of size and type, or nature of fuel—is faced with the certainty of rising fuel costs. Increased labor charges at mine and well, coupled with higher railroad and marine transportation tolls, indicate an inevitable upward trend in the cost of B.T.U.'s delivered.

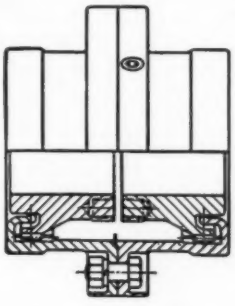
PARACOIL HEAT EXCHANGERS have been fighting this tendency for years, by reducing fuel costs through recovery of waste heat. Wherever hot liquids or gases are being allowed to go to waste, there "PARACOIL" can do a fuel saving job, often at remarkably low initial cost.

"PARACOIL" EXCHANGERS for Waste Heat Recovery are available as:

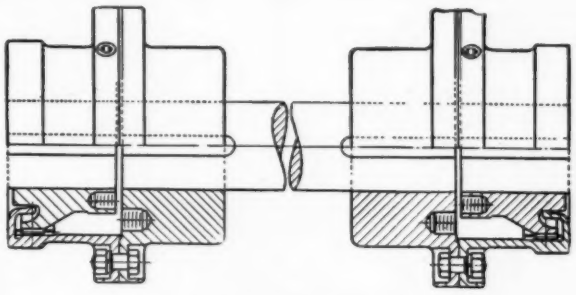
BOILER BLOWDOWN EXCHANGERS · DIESEL EXHAUST GAS WASTE HEAT BOILERS* · WASTE CONDENSATE COOLERS LAUNDRY WASH-WATER RECLAIMERS · FEED WATER HEATERS PROCESS WASTE HEAT RECLAIMERS · LIQUID TO LIQUID EXCHANGERS · GAS TO LIQUID EXCHANGERS

*For those particularly interested in the recovery of waste heat in Diesel Engine Exhaust Gases, we have available our BULLETIN NO. 301. Copies will be sent to anyone writing on his company letterhead. We *solicit your inquiries.*

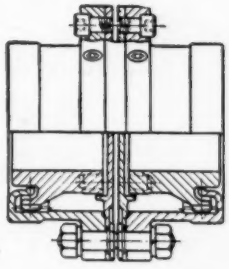
DAVIS
ENGINEERING CORPORATION
1064 East Grand Street, Elizabeth 4, N. J.
SAVE WITH "PARACOIL"



STANDARD



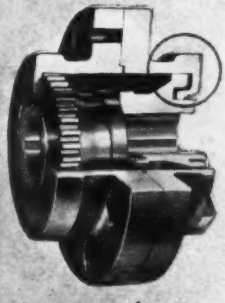
FLOATING SHAFT



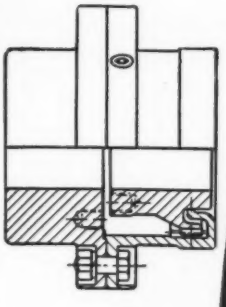
BREAKING PIN

WHATEVER YOUR CHOICE . . .

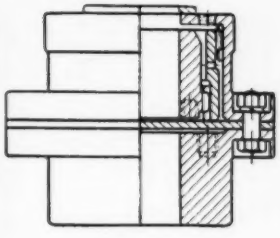
FAST'S GIVES YOU THIS EXTRA SAFEGUARD!



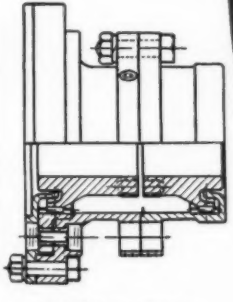
ALL - STEEL CONSTRUCTION! NO PERISHABLE PARTS! Those statements apply to Fast's self-aligning couplings — uniquely designed to give you uninterrupted power transmission. The *exclusive* "rocking bearing" (circled) is an example of Fast's thoroughness. It provides a positive metal-to-metal seal for the load-carrying oil, permanently protecting it against moisture, dust and grit. No perishable packing rings are used. There's nothing to wear, nothing to fail. ¶ Years of engineering experience, Koppers' high standard of workmanship and unexcelled coupling service pay off in longer machine life, lower upkeep costs and minimum shutdown losses . . . when you choose your Couplings from Fast's big, complete line. Prompt delivery. Write for our catalog to: Koppers Co., Inc., Fast's Coupling Dept., 241 Scott St., Baltimore 3, Md.



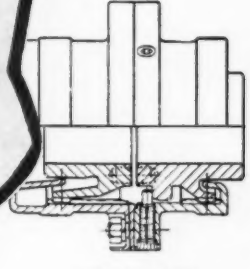
SINGLE ENGAGEMENT



VERTICAL



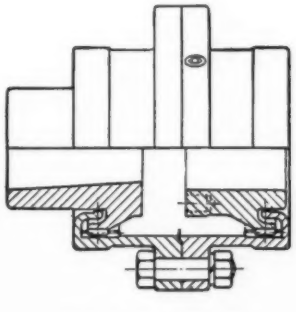
SHEAR PIN



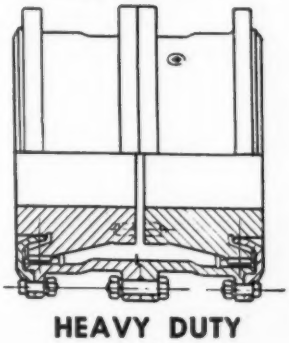
CUT-OUT

K KOPPERS

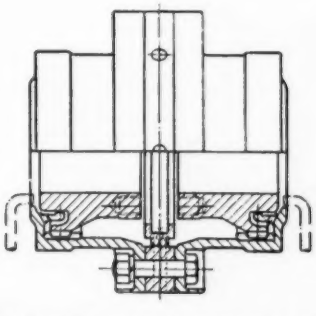
FAST'S *self-aligning* **COUPLINGS**



MILL MOTOR



HEAVY DUTY



CONTINUOUS LUBRICATING

For Resistance to Heat and Fumes LOOK Beneath the Braid

1 Take a sample of Rockbestos A.V.C. Power Cable, illustrated, or similarly insulated Motor Lead Cable, slit open the heavy asbestos braid (a) which is resistant to heat, flame, moisture, oil, and grease, and you'll find beneath a firewall of felted asbestos (b) a permanent heat-barrier against high ambient temperatures.

2 Then cut through this felted asbestos wall (b) peel it back, and see the high-dielectric moisture-resistant varnished cambric tape (c) it protects from heat, flame and oxidation. Notice, too, the uniform coverage of the tapes, helically applied like the felted asbestos to assure perfect and permanent centering of the conductor in the insulation.

3 Now unwind the varnished cambric tapes (c) which will peel easily, and you'll see the obvious advantage of multi-layer tape application—*not one thickness but many.* And under the tapes you'll also see a second felted asbestos wall (d) the inner heat-barrier which completes the protection of the varnished cambric.

4 Finally, slit and peel back this felted asbestos wall, (d) which prevents conductor-heating overloads from breaking down the varnished cambric, and you'll see the paper separator (e) that keeps the conductor clean of insulation and makes stripping easy. And that completes the story of Rockbestos A.V.C. *the wire with permanent insulation.*

A casual inspection isn't enough when it comes to selecting wire and cable for performance in hot-spot service. You've got to look *beneath* the braid! When circuits must operate next to boilers, furnaces, steam lines, drying ovens, resistor grids and soaking pits it is vitally important that the wire is *completely* insulated to withstand heat and moisture, corrosive fumes, oil, grease and flame.

The photos and text above tell the "inside story" of the reasons why Rockbestos A.V.C. Power, Motor Lead and Lighting Wires and Cables (National Electrical Code, Type AVA) will protect circuits and reduce maintenance . . . why their *permanent insulation* makes possible *continuous operation* at 230° F., under varied severe conditions without baking brittle, flowing or rotting.

Send for a sample, look beneath the braid, and see for yourself why Rockbestos A.V.C. gives more service per foot in the worst places. Several types for power, lighting and control circuits, switchboards and equipment, in 600 to 5,000 volt ratings. Just ask for what you are interested in. Write to:

ROCKBESTOS PRODUCTS CORP., 616 Nicoll St., New Haven 4, Conn.

ROCKBESTOS A.V.C.

The Wire with Permanent Insulation

125 different permanently insulated wires, cables and cords

developed by Rockbestos for various severe operating conditions

NEW YORK BUFFALO CLEVELAND DETROIT
PITTSBURGH ST. LOUIS LOS ANGELES OAKLAND, CALIF.

COFFIN TURBO PUMPS

HIGH SPEED . . . SINGLE STAGE

1 STANDARIZED . . . INDIVIDUALLY ENGINEERED for EACH JOB . . . and AVAILABLE for EARLY DELIVERY

because:

. . . variable speed turbine drive, plus a few frame sizes, plus several sizes of variable internal parts, constitute such an infinite number of possible combinations that the requirements of each application can be met exactly without delay.

Thus:

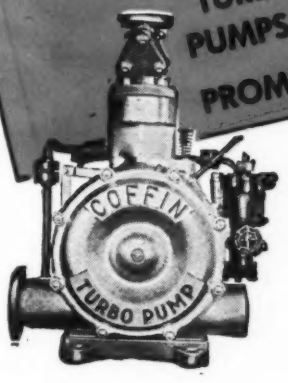
A FEW SIZES OF THESE FRAMES

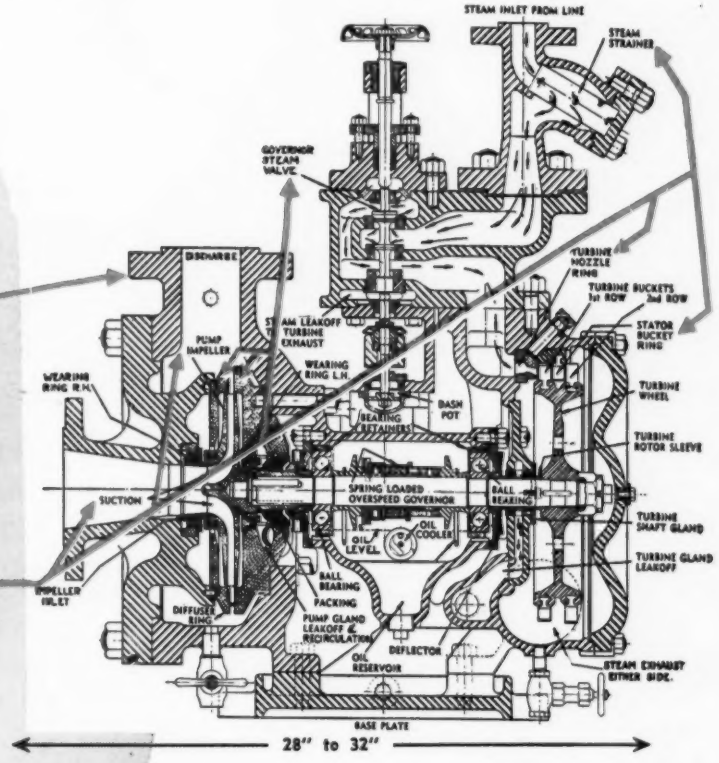
plus:

SEVERAL SIZES OF THESE PARTS

provide:

an endless number of combinations of COFFIN TURBO PUMPS . . . PROMPTLY





Standardized Boiler Feed Units for:

Steam Pressures to 650 PSI
Steam Temperatures to 850 F
Back Pressures to 60 PSI

Pump Capacities to 500 GPM
Discharge Pressures to 750 PSI (Heads to 1800 feet)
Liquid Temperatures to 300 F

UNIQUE FEATURES

1. Standardized Steam Turbine Centrifugal Pump and Governor Sets, individually engineered, assembled, and tested . . . for IMMEDIATE SHIPMENT.
2. No destructive casing erosion-corrosion.
3. No interstage leakage.
4. Wide range exact pressure governing.
5. Loss of suction reduces speed without tripping; automatic speed recovery with suction restoration.
6. High efficiency pump plus high speed two-bucket row turbine result in minimum steam consumption.
7. Matched Pump, Turbine and Governors under one responsibility.
8. Exact hydraulic and mechanical balance—light weight rotor—large bearings; result: bearing troubles practically unknown.
9. Pump Gland Leakoff provides adequate recirculation; suction pressure only on packing.
10. Rigid one-piece steel casing plus heavy shaft plus ample clearances result in no damage from dry operation.
11. All parts made to gage and replaceable without fitting; all parts in stock at factory with wearing parts available from agencies' stocks.
12. Proved for performance over a period of more than twenty years in service.
13. Compact, light in weight, quiet and low in maintenance.

Literature sent on request; specific proposals on receipt of operating date.

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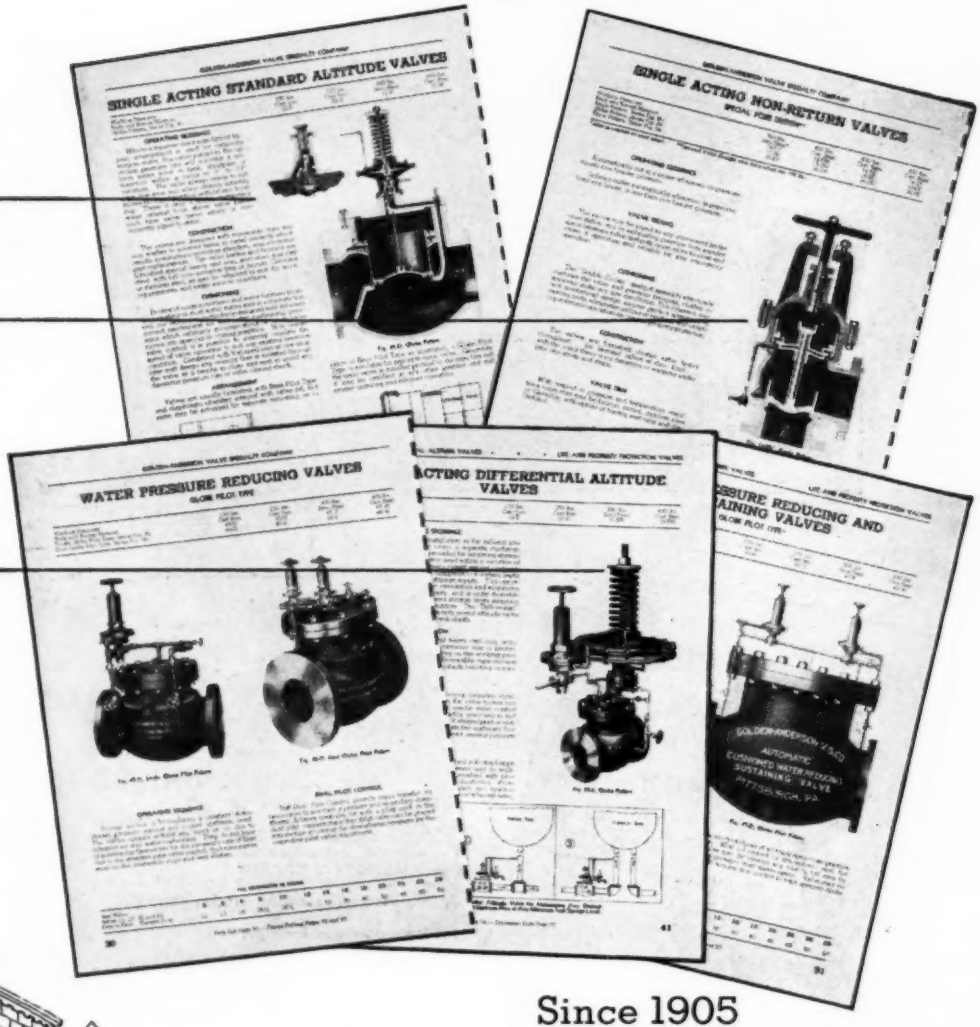
Golden-Anderson

VALVES

over 1500 types and sizes

for engineered protection


SINGLE ACTING STANDARD ALTITUDE VALVES
SINGLE ACTING NON-RETURN VALVES
WATER PRESSURE REDUCING VALVES
ACTING DIFFERENTIAL ALTITUDE VALVES

Since 1905

For more than 35 years Valves by Golden-Anderson have proven satisfactory in the protection of life and property. Engineer-designed to give safe, dependable control under even the most difficult and adverse conditions. For complete informative and technical data, send our engineering department your most difficult assignment.

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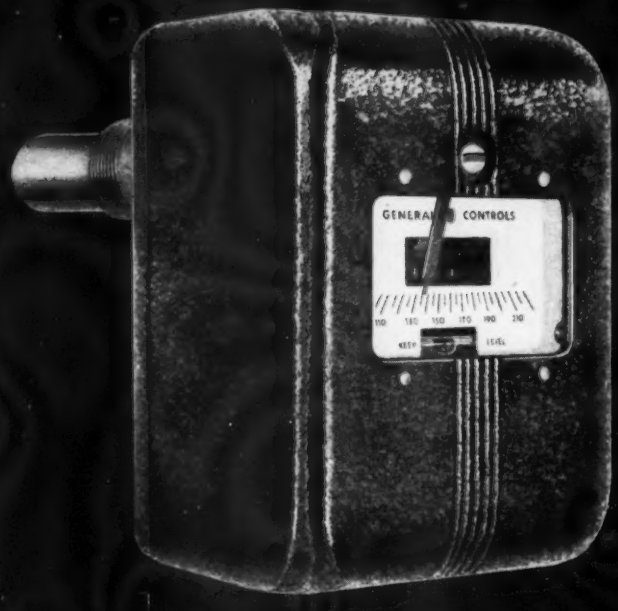
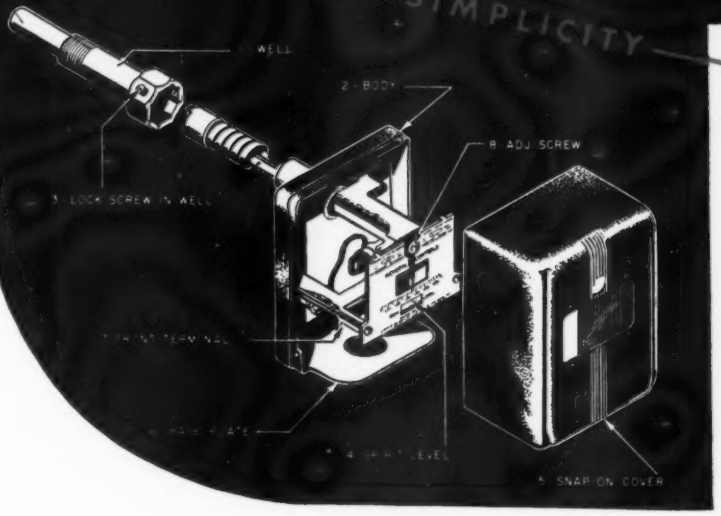
Keenan Building · Pittsburgh 22, Pa.

8 FEATURES of the New L-578 series IMMERSION THERMOSTATS



ADVANCED DESIGN SIMPLICITY



★ **Accurate and positive in action.**

★ **Visual leveling indicator.**

★ **Complete selection of temperature ranges and switch combinations**—*Models to meet every requirement.*

★ **Fast reaction to liquid temperature change**—*Two-inch well provides large heat-exchange area for both direct and proximity contact with temperature-sensitive element.*

★ **Close temperature differential**—*Approximately 10° F. in most installation conditions.*

★ **Temperature setting easily changed**—*Just one external adjustment screw to turn.*

★ **Ample current capacity for use in all standing control systems**—*Up to 15 Amp. switch rating.*

★ **Mercury type switch**—*Dust-proof, tamper-proof, impervious to corrosive atmospheric conditions and "pitting" characteristics.*

For complete specifications request Bulletin SDL-32R-2.

GENERAL CONTROLS

501 ALLEN AVENUE GLENDALE 1, CALIF.

Manufacturers of Automatic Pressure, Temperature & Flow Controls

FACTORY BRANCHES: BIRMINGHAM (3) • BOSTON (16) • CHICAGO (5) • DALLAS (2) DENVER (10) • DETROIT (8) • CLEVELAND (15) • HOUSTON (2) • KANSAS CITY (2) NEW YORK (17) • PHILADELPHIA (40) • PITTSBURGH (22) • SAN FRANCISCO (7) • SEATTLE (1)

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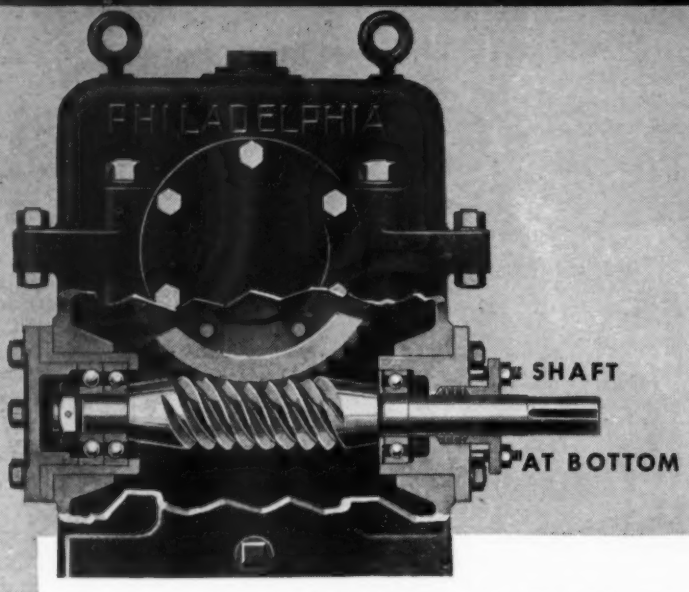
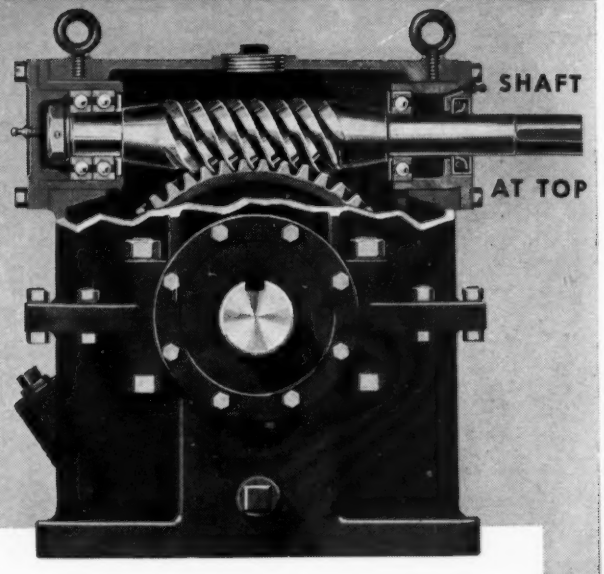
PHILADELPHIA WORM GEAR SPEED REDUCERS

. . . a type and size for every industrial need



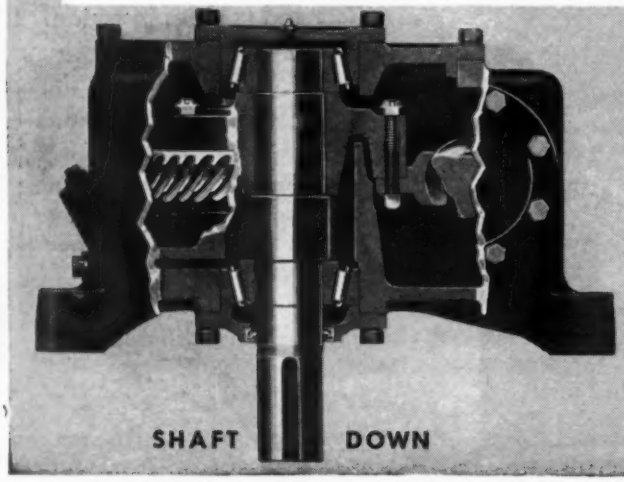


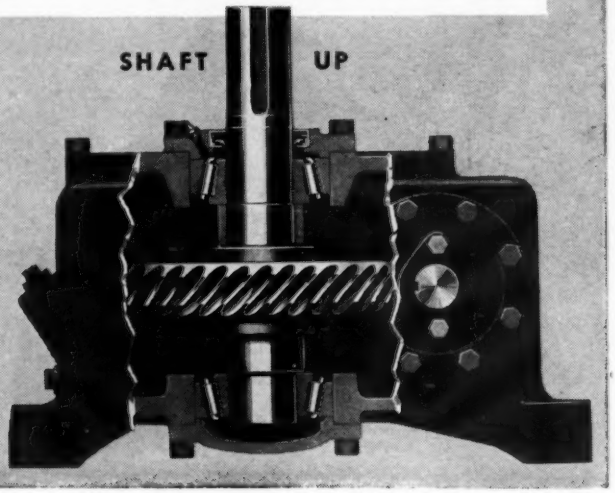
The development of Philadelphia Worm Gear Reducers to their present state of efficiency, represents a distinct engineering achievement. Scientific design, unexcelled workmanship, best materials, rugged construction, noiseless and vibrationless operation, long life, performance that is dependable (almost to the point of complete neglect) . . . these are some of the qualities that have earned an enviable reputation for this outstanding line of Reducers.

"Tomorrow's" advanced high standards are offered for "Today's" selection . . . for immediate, efficient and economical hook-up with your present production schedules.

Needless to say, this degree of perfection was not accomplished by accident. As a pioneer in the field, the Philadelphia Gear Works has, by continuous research and experimentation, developed the many important refinements which are exclusive with this line. Truly, they represent a new peak in design and efficiency of worm gear speed reducers.

EACH UNIT HAS CUSTOM-BUILT QUALITIES . . . As a result, Philadelphia Worm Gear Speed Reducers are not produced en masse, according to a set pattern. While the same fundamental principles are embodied, and a certain group may have the same appearance, and the same standard, easily replaceable parts—each unit is handled as a special assignment. It has built into it the individual service characteristics that will perform the required job with maximum efficiency, economy and with minimum maintenance. Send for new Worm Reducer Catalog No. 26, just off the press.





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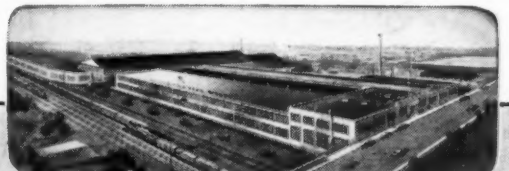
NEW YORK • PITTSBURGH • CHICAGO . . . IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO



Industrial Gears and Speed Reducers
LimiTorque Valve Controls

You Get **BETTER PERFORMANCE**

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Edge Moor 4-Drum Bent Tube Boiler

80 years of Edge Moor designing and engineering skill has been incorporated into the Edge Moor 4-Drum Bent Tube Boiler to offer you the utmost in continuous service, dependability, efficiency of operation . . . a PLUS in greatest investment return.

This unit is especially designed to provide a maximum of water storage and steam liberation space, a quiet offtake drum and positive circulation at all ratings. The arrangement of tube banks is flexible, permitting the installation of various types of superheaters.

Edge Moor 4-Drum Bent Tube Boilers are available in a wide range of capacities, pressures and total temperature requirements. They are adaptable to all fuels and can be supplied with all boiler auxiliaries.

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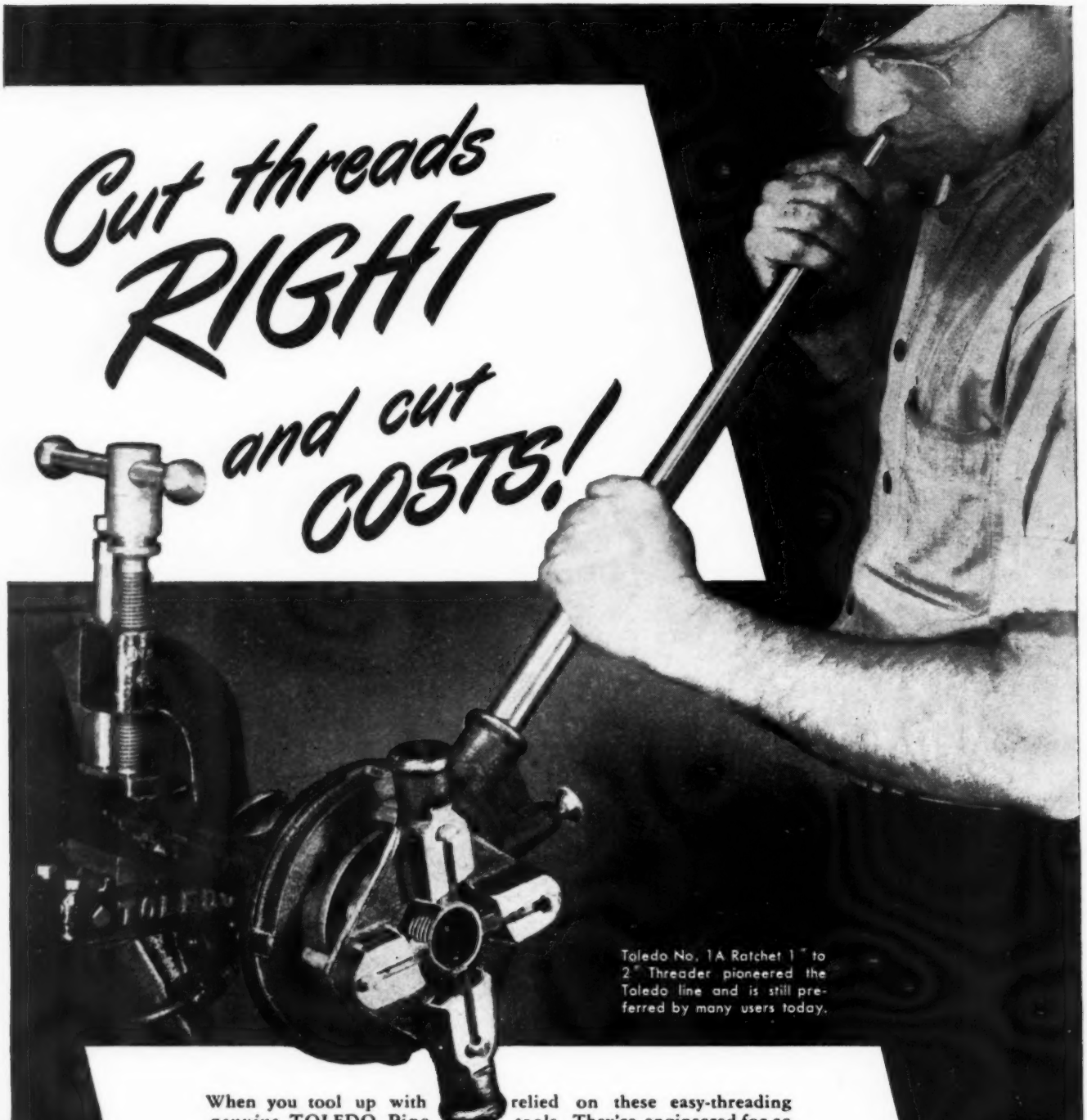
EM

Cut threads RIGHT and cut COSTS!



Toledo No. 1A Ratchet 1" to 2" Threader pioneered the Toledo line and is still preferred by many users today.

When you tool up with *genuine* TOLEDO Pipe Tools you are tooled up right! A good tool saves labor...cuts costs...and keeps workmen satisfied. That's why there's such great demand everywhere for TOLEDO Tools and Power Pipe Machines! For nearly half a century, thousands of better mechanics have relied on these easy-threading tools. They're engineered for accuracy, and time saving operation. This assures better threads...with less effort and lower cost! Specify TOLEDO—for all-around satisfaction! The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office, No. 2 Rector Street Building.

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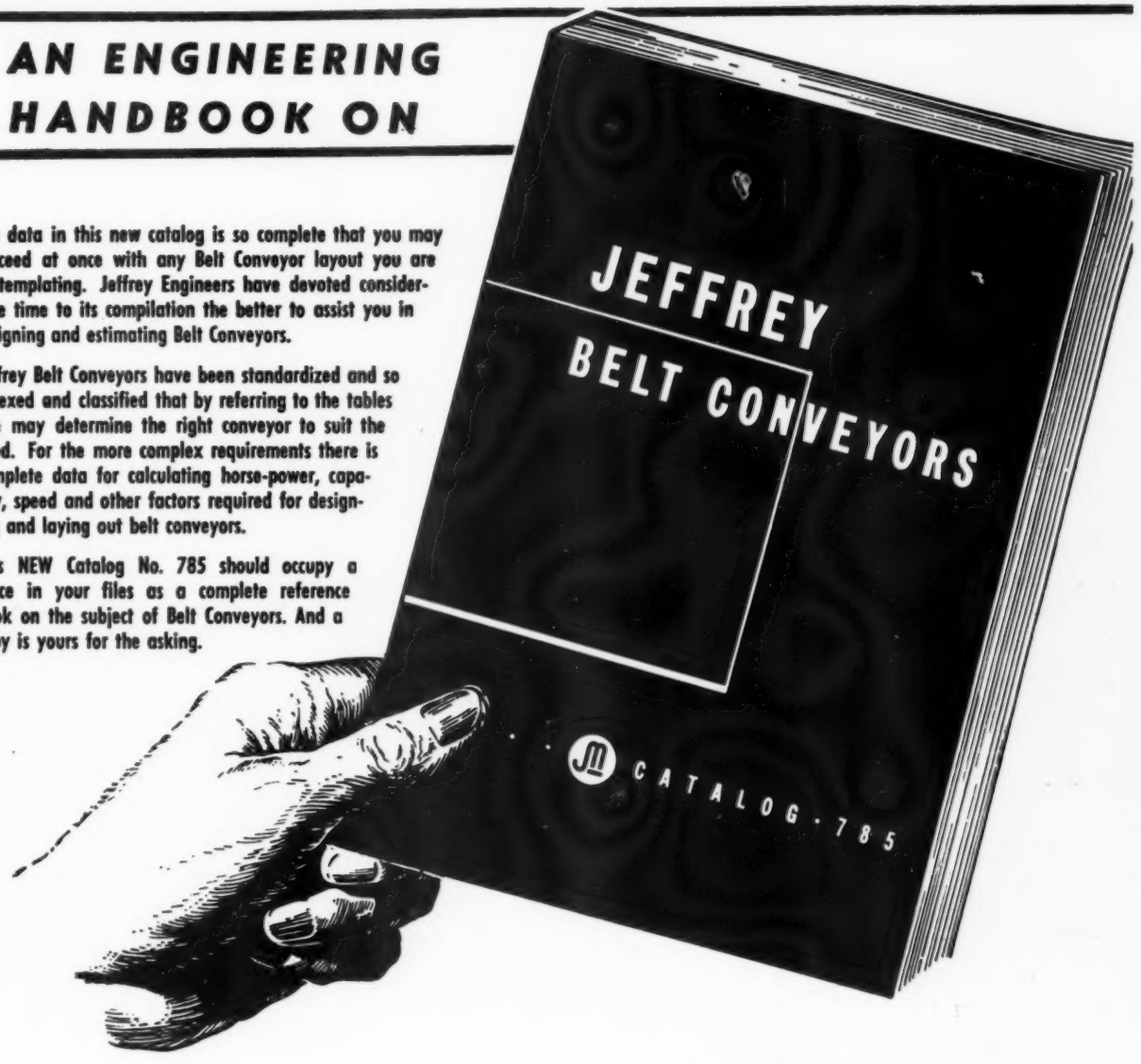
TOLEDO

FOR PRECISION PIPE TOOLS

Here, Sir, is a New Catalog

AN ENGINEERING HANDBOOK ON



The data in this new catalog is so complete that you may proceed at once with any Belt Conveyor layout you are contemplating. Jeffrey Engineers have devoted considerable time to its compilation the better to assist you in designing and estimating Belt Conveyors.

Jeffrey Belt Conveyors have been standardized and so indexed and classified that by referring to the tables one may determine the right conveyor to suit the need. For the more complex requirements there is complete data for calculating horse-power, capacity, speed and other factors required for designing and laying out belt conveyors.

This NEW Catalog No. 785 should occupy a place in your files as a complete reference book on the subject of Belt Conveyors. And a copy is yours for the asking.

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The Jeffrey Manufacturing Company

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Please send me a copy of Catalog No. 785.

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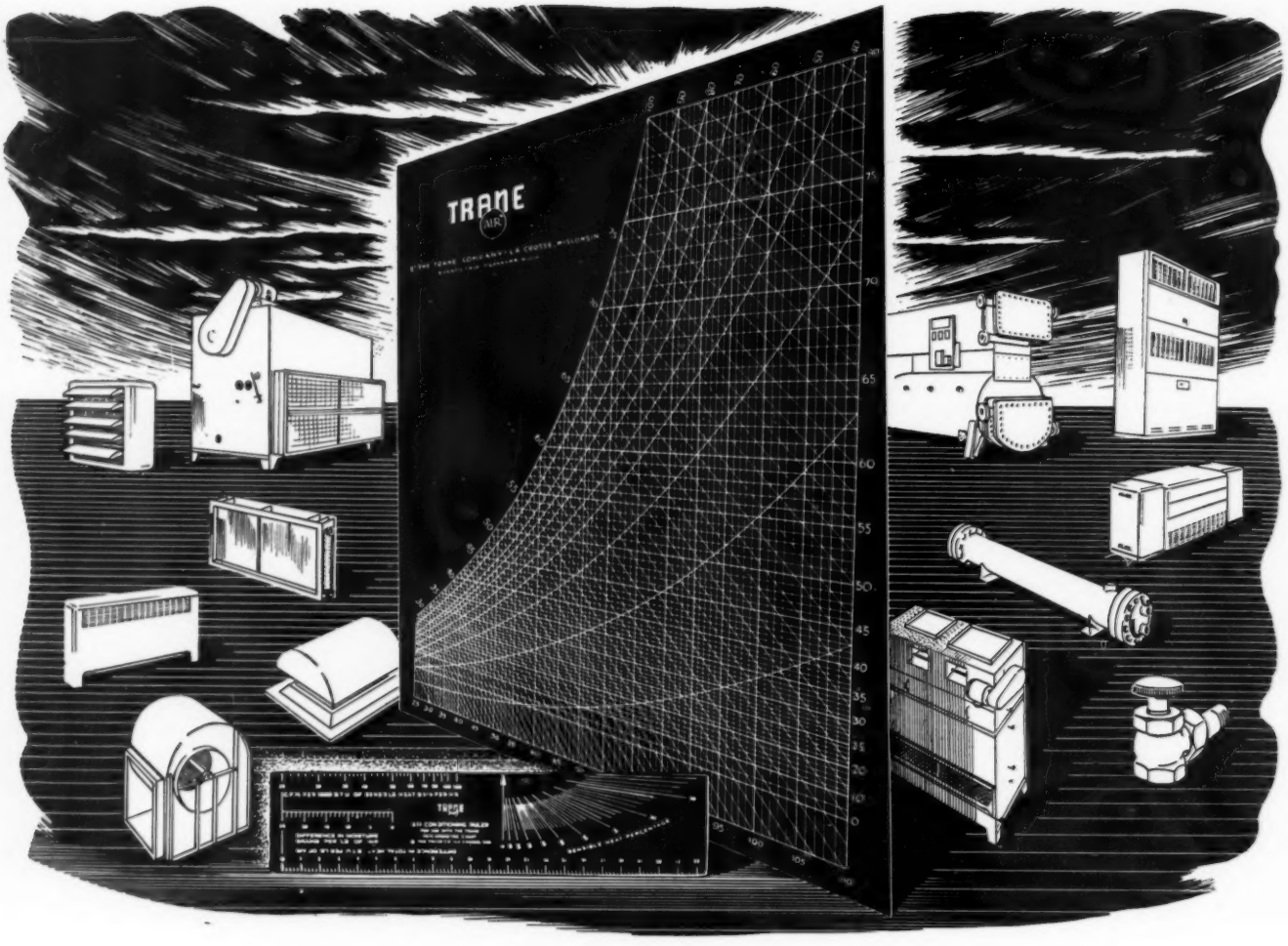

The Straight Line to ENGINEERED AIR CONDITIONING

Achieving the desired temperature and moisture content of air are complicating factors in the design of air conditioning systems. Calculations were long and complex until Trane engineers developed the Air Conditioning Ruler to be used with the Trane Psychrometric Chart. Now professional men—and students as well—use the Ruler and Chart to solve the problems of air conditioning quickly and easily.

As the Air Conditioning Ruler and the Psychrometric Chart are made available by Trane to aid the profession, so it is with Trane products. The complete line of Trane heating and air conditioning products is designed and built by manufacturing engineers to give architects, consulting engineers, and contractors a *single source* for the necessary elements in entire heating and air conditioning systems.

Trane heating systems and air conditioning systems—made possible by the complete line of Trane products—are designed for each application by architect, engineer, or contractor. 85 Trane field offices are ready to help them.

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The Convector-radiator—modern successor to the old-fashioned cast iron radiator—has been engineered by Trane for universal application to steam and hot water heating systems, and is being produced in quantity so you can now secure it from local distributors' stocks.

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HEATING AND AIR CONDITIONING

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A Distributor serves you Best

Republic Cotton Reinforced Steam Hose, designed for industrial applications, operates under pressure up to 150 pounds for innumerable uses. The body is constructed with multiple plies of strong, hard woven, pressure resisting duck. Tube, friction, and cover provide maximum heat resistance.

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POINT NUMBER ONE IN REPUBLIC'S FIVE POINT POLICY

A line of rubber items sufficiently complete to permit effectively supplying the requirements of the trade solicited.

Whom do you call when an unforeseen breakdown occurs that may stop your production many hours, days, or even weeks? It's your distributor of industrial supplies. Since he carries a big inventory of items for not one but many companies, he usually has just what you need to restore your costly production operations. He delivers the critical item on the spot immediately.

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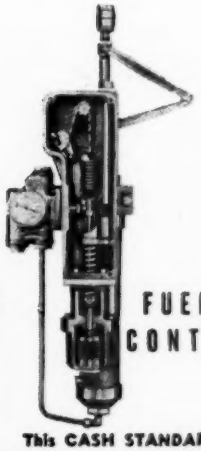
PLAN YOUR BOILER ROOM COST CUTTING AROUND CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

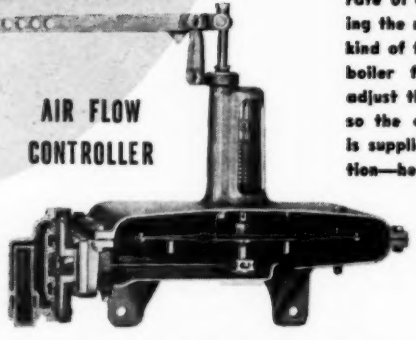


FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion—hence, money saving.

FURNACE DRAFT CONTROLLER

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



AIR FLOW CONTROLLER

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

THE first step in gaining operating economy can well begin with a CASH STANDARD Automatic Combustion Control System. Then you at once establish savings such as: 1 — in fuel (coal, oil, or gas), 2 — in maintenance, 3 — through the fact that you get more steam from your present boiler using less fuel.

Whether you have a single boiler or battery of boilers you can get the desired economy results. The reason is you constantly maintain the correct fuel feed — the correct fuel-air ratio and correct over-fire draft.

SEND FOR BOOKLET No. 300...

TELLS about the three requirements for cost saving Combustion Control and how the CASH STANDARD System effectively and continuously does the job.

It shows applications of the CASH STANDARD Systems — if you burn coal, oil, or gas. It tells how combinations of the various CASH STANDARD units can be made to meet any specific condition and work on any boiler or stoker with any kind of fuel.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

STAINLESS STEEL WELDING FITTINGS

BY MIDWEST

Illustrated here are the various standard Stainless Steel Midwest Welding Fittings. Types 316 and 347 are carried in stock; type 304 and other analyses can be furnished on order. Fittings are hot formed, annealed and pickled; they conform with ASA Specifications for Steel Butt-Welding Fittings.

MIDWEST PIPING & SUPPLY CO., Inc.

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Sales Offices: **New York (7), 30 Church St.**
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3174

MIDWEST WELDING FITTINGS IMPROVE DESIGN AND REDUCE PIPING COSTS

WALWORTH

Pressure-Seal Valves

The greatest improvement in high-pressure, high-temperature valve design

WHY?

Because the fundamental principle of the design of the Walworth Pressure-Seal Valve is such that the internal pressure makes the body-to-bonnet joint tight. This tightness extends over the range of all practical conditions, including "carry-over", sudden changes of temperature, and sudden changes of pressure.

The body-to-bonnet joint is easily disassembled and assembled in a minimum of time, reducing the period the pipe line is out of service.

Valve maintenance is reduced to a minimum.

These valves have a semi-flexible disc which compensates for changes in the body shape due to temperature and pressure variations.

An improved guide extends over the entire travel of the disc, making the Walworth Pressure-Seal Valve easier to open and close.

Valve ports and guides are designed to give streamline flow.

The strength of Walworth Pressure-Seal Valves is greater than that of previous designs, even though the weight is reduced approximately 50 per cent.

Walworth Pressure-Seal Valves are now available in the following sizes: Series 900 — 3" and larger; Series 1500 — 1" and larger.

LOOK AT THESE ADVANTAGES

1. BONNET TIGHTNESS
2. NO BONNET BOLTS OR WELDS
3. IMPROVED YOKE DESIGN
4. EASILY AND QUICKLY ASSEMBLED
5. EASILY AND QUICKLY DISASSEMBLED
6. DISC TIGHTNESS
7. IMPROVED GUIDE
8. STREAMLINE FLOW DESIGN
9. EASY TO CLOSE
10. EASY TO OPEN
11. VALVE STRONGER
12. WEIGHT REDUCED
13. SPACE REDUCED

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valves and fittings

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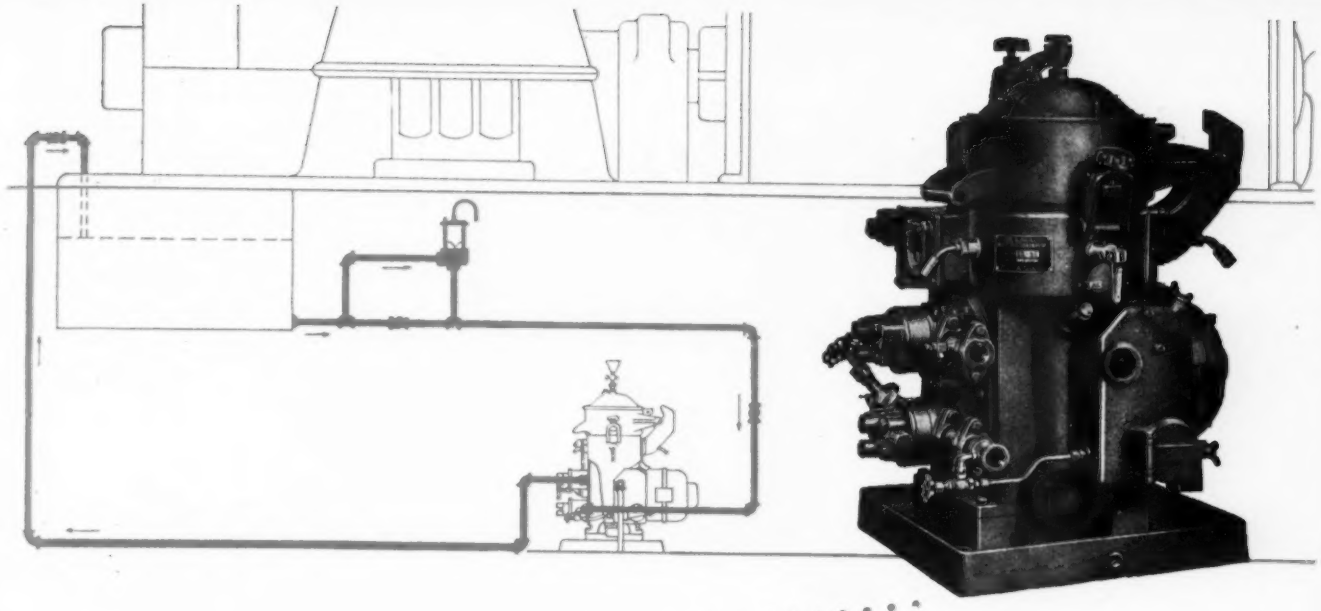

Condensate or dirt—
THIS OIL PURIFIER REMOVES BOTH PROMPTLY

A DE LAVAL Oil Purifier removes water and dirt by means of centrifugal force. Action is entirely mechanical — water is discharged as fast as it is separated from the oil; dirt is stored in the periphery of the bowl, out of the zone of purification.

The simplest of all continuous De Laval purification systems is the by-pass system shown above. Such a system utilizes a Purifier for each turbine unit, with a sight overflow glass. As purified oil is pumped back into the oil reservoir, it raises the oil supply level so that the dirtiest oil in the bottom of the reservoir flows through the sight glass to the Oil Purifier. The system may be installed either beneath the turbine (as shown) or on the turbine floor.

A De Laval Oil Purifier of proper size will pass the total quantity of oil in the reservoir through the Purifier three or four times daily, affording full protection to the turbine.

De Laval Oil Purifiers

FOR MORE DEPENDABLE POWER PRODUCTION

THE DE LAVAL SEPARATOR COMPANY
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DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

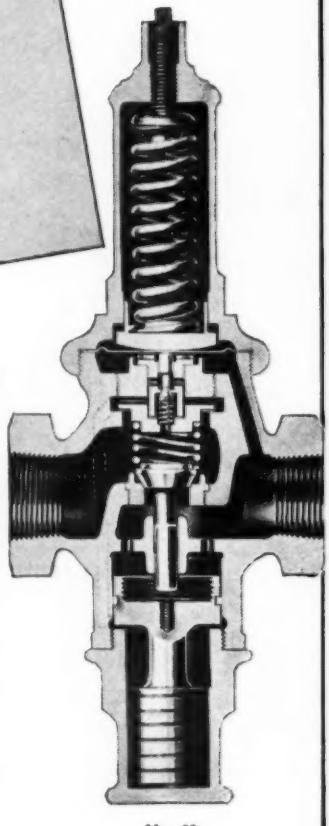
Masoneilan

NO. 11 REGULATORS

Cut Your

Masoneilan No. 11 Pressure Regulators reduce waste by holding pressures where you want them. Their tough, rugged construction assures dependable operation in all types of service . . . gives long-lived performance for years on end. In fact, you'll find many of these No. 11 Regulators still performing accurately with an on-the-job record of over 20 years.

Investigate Masoneilan No. 11 Pressure Regulators, today. They will give you accurate service and cut maintenance costs.



No. 11
Pressure Regulator

USE A MASONEILAN STRAINER

in all water, steam or air lines to protect valves, traps, etc., from scale, dirt or other foreign matter. These strainers are precision-built for long reliable service. They cost no more than others.

MASON-NEILAN REGULATOR COMPANY

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New York, Chicago, St. Louis, Philadelphia, Houston, Cincinnati, Buffalo, Pittsburgh, Tulsa, Los Angeles, Cleveland, Atlanta, San Francisco, Mason Regulator Co. of Canada, Ltd., Montreal and Toronto

MASONEILAN EQUIPMENT STOCKED BY:

Akron, Ohio, Hardware & Supply Co.
Atlanta, Ga., Grinnell Corp.
Baltimore, Md., Morton McI. Dukehart
Bassett, Va., Blue Ridge Hardware & Supply Co.
Battle Creek, Mich., Galloup Pipe & Supply Co.
Binghamton, N. Y., Chas. Millar & Son Co.
Birmingham, Ala., The Young & Vann Supply Co.
Boston, Mass., Atlantic Pipe & Supply Co.
Boston, Mass., Braman Dow & Co.
Boston, Mass., Walworth Co.
Buffalo, N. Y., Root-Neal & Co.
Buffalo, N. Y., Stritt & Priebe, Inc.
Cambridge, Mass., Boston Pipe & Supply Co.
Cambridge, Mass., Metropolitan Pipe & Supply Co.
Charlotte, N. C., The Textile Mill Supply Co.
Chattanooga, Tenn., Hajoca Corp.
Chester, Penna., Desco Corp.
Chicago, Ill., Barrett-Christie Co.
Cleveland, Ohio, Grinnell Co., Inc.
Cleveland, Ohio, W. M. Pattison Supply Co.
Columbia, S. C., Columbia Supply Co.
Columbus, Ohio, The Ross-Willoughby Co.
Cranston, R. I., Grinnell Co., Inc.
Detroit, Mich., Coon-De Visser Co.
Durham, N. C., Dillon Supply Co.
Erie, Pa., Coblentz Equipment Co.
Evansville, Ind., Evansville Supply Co.
Fall River, Mass., Fall River Steam & Gas Pipe Co. Corp.
Fresno, Calif., Central Supply Co.
Goldsboro, N. C., Dillon Supply Co.
Grand Rapids, Mich., Barclay Ayers & Bertsch Co.
Greensboro, N. C., Smith-Courtney Co.
Greenville, S. C., Carolina Supply Co.
Harrisburg, Penna., Appleby Bros. & Whittaker
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Indianapolis, Ind., Indianapolis Belting & Supply Co.
Jackson, Mich., Galloup Pipe & Supply Co.
Jackson, Miss., J. E. Dilworth Co.
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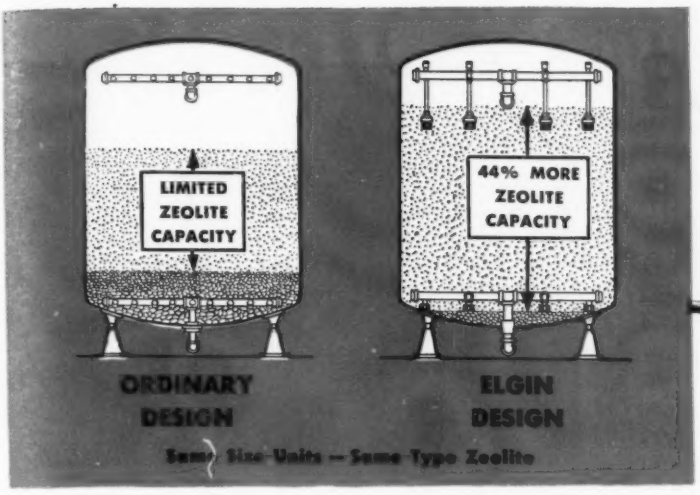
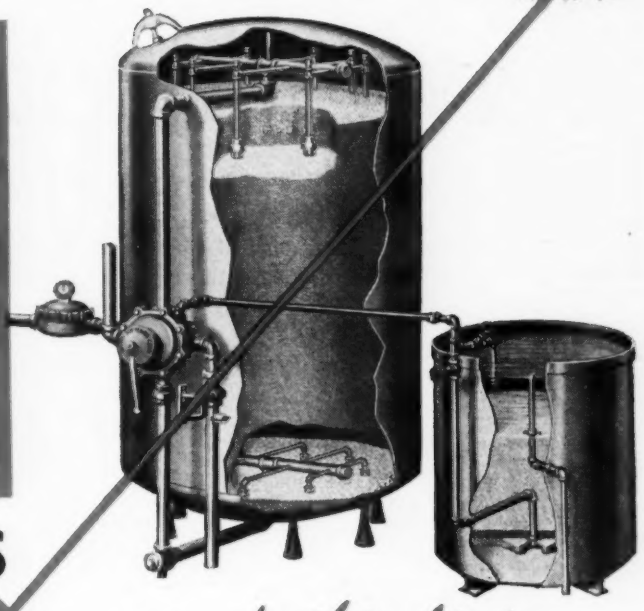
MASONEILAN

Yes, Mister, it's a big claim...but it's true





ELGIN WATER SOFTENERS

Double-Check Eldurite Design

GIVE 44% MORE SOFT WATER

Our statements on Elgin's amazingly greater water softening capacity have been challenged on good common sense grounds. In any field one product may be a little more efficient than its competitors. But how come Elgin can be so *much* more effective than other water softeners?

Actually, the answer is very simple. In any zeolite softener it's the zeolite that removes the water-hardening elements. So the amount of water any zeolite softener can soften depends on the amount of zeolite it can properly hold. Most softeners are limited in the amount they can contain because after a certain depth in the zeolite bed is reached, escape of zeolite through the manifolds cannot be prevented.

The Elgin uses more zeolite — almost half again as much as other softeners — because its ingenious, fully patented "Double-Check" manifolds prevent zeolite loss under all operating conditions—softening, backwashing, or regeneration.

That's the reason for greater capacity: More zeolite—more soft water—in fact, a 44% increase or more. But there is also a gain in efficiency—extra gallons of softened water at no extra cost. By preventing escape of zeolite, a higher backwashing rate is possible, assuring complete regeneration and maximum softening capacity.

Extra gallons from your present softener, too. Existing softeners, regardless of make, can be modernized economically to incorporate the patented features and advantages of this Elgin "Double-Check" principle.

✓Check this list of Water Treatments

Elgin has an economical solution to every water treatment need. Treatments include:

1. **Elgin Boiler Feedwater Treatment**—individually prescribed based on plant survey; specifically formulated and guided by laboratory and field service.
2. **Elgin Post Treatment for softened water.** When fed to boilers, softened water (either zeolite or lime-soda) needs Elgin Post Treatment to guard against corrosion and the effects of contaminated condensate.
3. **"Elgex" Treatment prevents corrosion** — in steam and condensate systems. Small amount does big job at low cost.
4. **Elgin Inhibitant Treatment** — remarkable in preventing and eliminating scale in water lines, condensers, cooling systems, boiler feed lines, pumps, heaters, etc.
5. **Elgin Anti-Corrosion Treatment** for hot and cold water lines—including distribution systems, process lines, etc. Establishes protective film which prevents corrosion.

COUPON BRINGS FACTS

I am interested in:

☐ **Elgin Water Softener**

☐ **Modernizing our water softener**

Water Treatment No. ..... (See numbers above).

Name_____

Company_____

Address_____

Mail to — ELGIN SOFTENER CORPORATION
130 North Grove Avenue, Elgin, Illinois

ELGIN SOFTENER CORPORATION

130 NORTH GROVE AVENUE, ELGIN, ILLINOIS

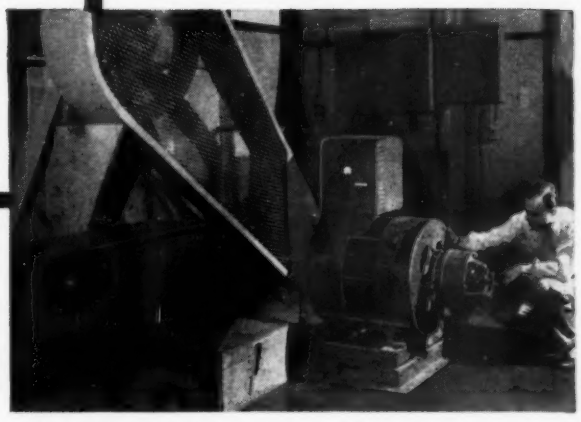
SOFTENERS • FILTERS • WATER TREATMENT
BOILER WATER CONDITIONING

How to carry
MORE POWER
over your lines

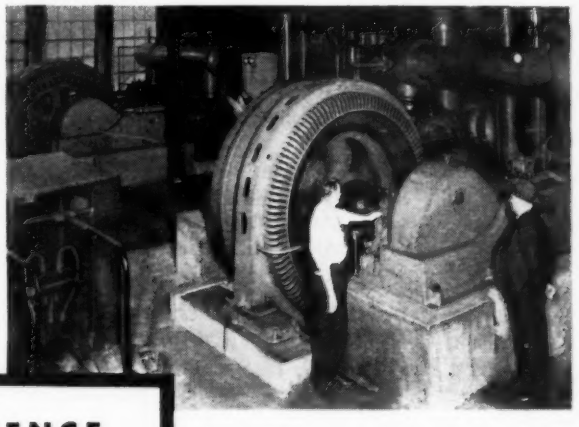
Power factor improvement—just one of the operating advantages of E-M Synchronous Motors—removes a burden from your power line. Synchronous Motors, in addition to driving their connected mechanical load, supply magnetizing current to offset the low power factor of induction motors and other equipment. Large-power Synchronous Motors may often be added to existing lines and transformers without raising kva to a level requiring larger feeders, transformers and control equipment.

Because transformers and distribution lines are limited in their kilowatt capacity by the total kva they must carry, Synchronous Motors—by furnishing leading kilovars—replace lagging kilovars in the line with kilowatts for useful work. Providing your own leading kilovars, rather than buying them from the power company, usually results in reduced power billing. As a further benefit, steady voltage is maintained on a higher level than would be the case at a lower power factor.

Besides these savings and advantages, E-M Synchronous Motors give you constant speed, wide range of speed ratings, high stability under voltage dips. It's this double-duty performance that makes them the most efficient drive in industry.

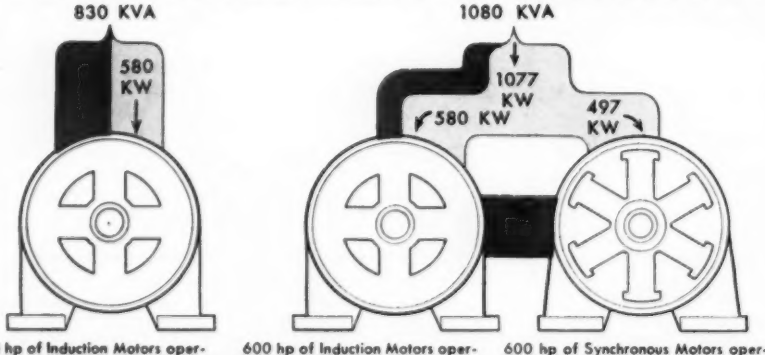


● One of five E-M Synchronous Motors applied to air conditioning fans to improve power factor in a large engine gear plant in Indiana. The motors are 60 hp, 1200 rpm.



● Both of these 500 hp, 180 rpm Synchronous Motors operating air compressors at Motor Products Corp., Detroit, Mich., feature power factor correction at 0.7 leading pf.

POWER FACTOR MAKES A DIFFERENCE



600 hp of Induction Motors operating at 0.7 lagging power factor —580 KW, 830 KVA, 590 KVAR.

600 hp of Induction Motors operating at 0.7 lagging power factor —580 KW, 830 KVA, 590 KVAR.

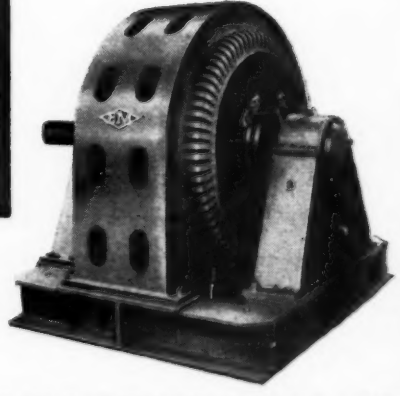
600 hp of Synchronous Motors operating at 0.7 leading power factor— 497 KW, 711 KVA, 507 KVAR.

In the system operating at low power factor the lagging kilovars carried by the line may equal or exceed the kilowatts doing useful work.

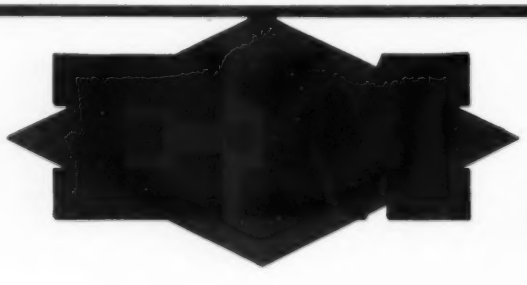
Addition of Synchronous Motor drives to this system permits doubling the horsepower capacity, with only a 30% increase in kva.

A2033

Write for "The ABC of Power Factor"



Send for 20-page illustrated booklet, "The ABC of Power Factor."



ELECTRIC MACHINERY MFG. CO.
Minneapolis 13, Minnesota

The Atlas Powder Company

STAMFORD, CONNECTICUT PLANT

solved its summer-winter peak loads with THERMIX Induced Draft and Dust Collecting Equipment

At this plant there are 4 boilers. The winter peak is 120,000 lbs. of steam per hour from 2 or more boilers. In the summer, the peak is 60,000 lbs. of steam per hour from 1 or more boilers.

Space was at a premium because of adjoining building walls and the Draft and Dust Collector Equipment had to be placed in operation without any cessation of service of the steam plant.

To answer the summer-winter peak load problem, a Thermix twin fan (Type 1-A) stack was installed directly above a Thermix Tubular Dust Collector divided into two cells, each of which served a fan. Both fans were adequate for the winter peak load while one fan and one Collector section easily carried the summer peak load.

It was necessary to install and place the unit in operation without interruption of steam flow. The gas was temporarily allowed to continue its original flow through an existing brick stack while the new equipment was being installed and placed in service. This was accomplished with no interruption.

Problems such as this are often solved by the use of Thermix Equipment. This solution was engineered and designed by The Thermix Corporation project engineers and they will be glad to aid you in your search for more efficient draft producing methods.

All inquiries should be directed to

THE THERMIX CORPORATION

Project and Sales Engineers

FIRST NATIONAL BANK BLDG., GREENWICH, CONN.

(Offices in 28 principal cities)

Equipment designed and manufactured by

PRAT-DANIEL CORPORATION

Manufacturing Plant, EAST PORT CHESTER, CONN.

BWH
DEPENDABLE RUGGEDNESS
Tough abrasion-resisting rubber covers and edges.
Carcass is made of multiple plies of high-tensile duck, with quality-controlled friction.

UNDERGROUND "TOUGHIES" SENT UP FOR 19 YEARS

Another top performance by a BWH product

19 years ago, in 1929, a leading copper concentrator needed a conveyor belt that could really "take it". Ponderous weights of copper ore had to be hauled from a primary crusher to the pulverizing mills. The belt had to resist cuts and tears from jagged rocks. And the cargo had to keep moving, week after week, at a minimum cost per ton.

It was a tough problem, but a Bull Dog Belt proved a highly satisfactory solution. In 12 years of steady operation, this husky belt carried more than 54 MILLION TONS! So when stepped-up production necessitated a replacement in 1941, another Bull Dog Belt was naturally specified.

Because Bull Dog Belts are made by the famous ROTOCURE process of continuous vulcanization, they are free from trouble spots caused by press overlaps. The carcass is made of multiple plies of duck with quality-controlled friction, and the cover is unusually tough and abrasion-resistant. Combined, these factors assure the resiliency essential to recovery from shock when "bruiser" loads come thundering in.

The new belt shown has been hard at work for over seven years, at the rate of 25 THOUSAND TONS OF COPPER PER DAY!

Records like these are common in the many industries where BWH products are used. Whatever your needs for mechanical rubber goods, look to BWH for dependable ruggedness — BWH distributors for dependable service.

HAVE YOU A JOB WHERE STAMINA COUNTS?

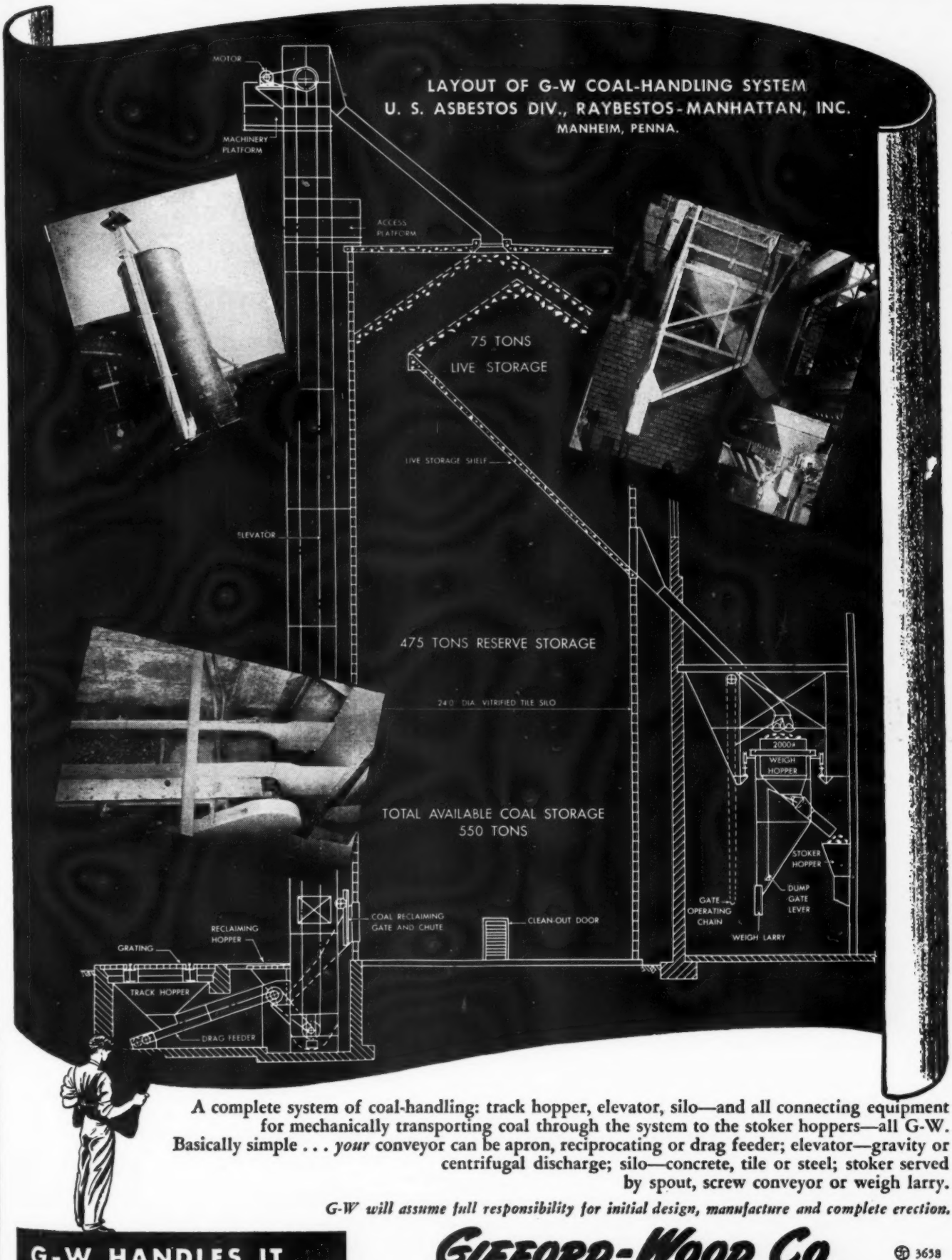
Bring us your toughest problems — we're specialists in solving them. Consult your nearest BWH distributor, or write directly to BWH.

Another Quality Product of

BOSTON WOVEN HOSE & RUBBER COMPANY

Distributors in all principal cities

PLANT: CAMBRIDGE, MASS., U.S.A. • P.O. BOX 1071, BOSTON 3, MASS.



A complete system of coal-handling: track hopper, elevator, silo—and all connecting equipment for mechanically transporting coal through the system to the stoker hoppers—all G-W. Basically simple . . . *your* conveyor can be apron, reciprocating or drag feeder; elevator—gravity or centrifugal discharge; silo—concrete, tile or steel; stoker served by spout, screw conveyor or weigh larry.

G-W will assume full responsibility for initial design, manufacture and complete erection.

G-W HANDLES IT . . .
faster • easier • cheaper

SINCE 1814

GIFFORD-WOOD CO.

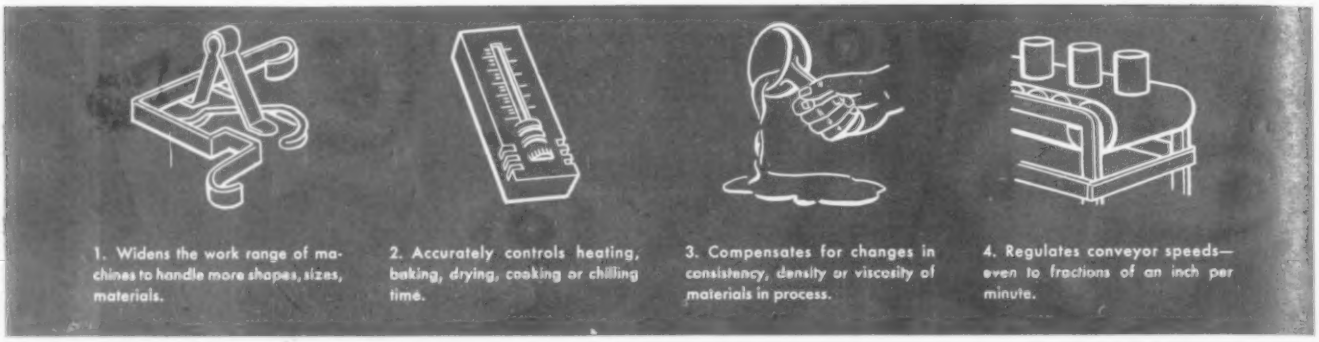
3658

NEW YORK 17
420 LEXINGTON AVENUE

Factory:
Hudson, N. Y.

CHICAGO 6
565 W. WASHINGTON ST.

8 Ways Reeves Speed Control Increases Production–Improves Quality

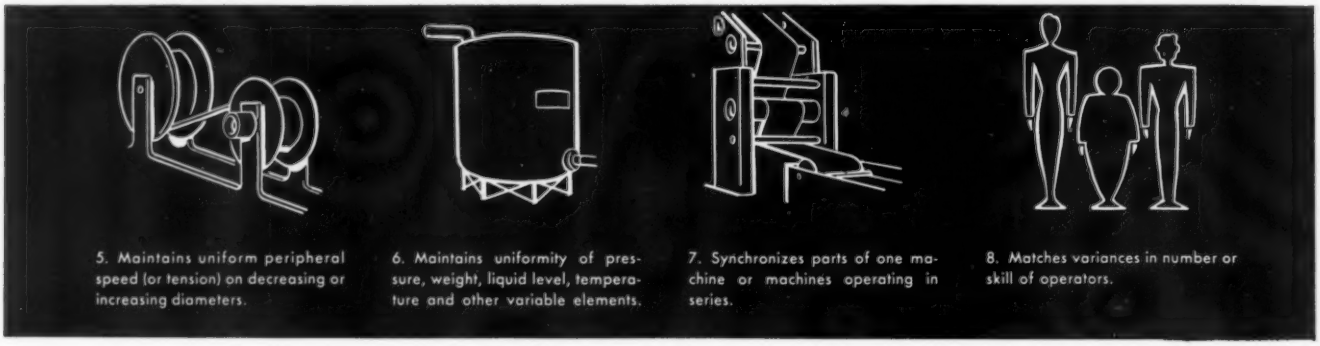


1. Widens the work range of machines to handle more shapes, sizes, materials.

2. Accurately controls heating, baking, drying, cooking or chilling time.

3. Compensates for changes in consistency, density or viscosity of materials in process.

4. Regulates conveyor speeds—even to fractions of an inch per minute.



5. Maintains uniform peripheral speed (or tension) on decreasing or increasing diameters.

6. Maintains uniformity of pressure, weight, liquid level, temperature and other variable elements.

7. Synchronizes parts of one machine or machines operating in series.

8. Matches variances in number or skill of operators.

Here's the tested and proved way to get instant, stepless speed adjustability on your machines—assuring exactly the right speed for every job, under every changing condition.

REEVES Speed Control is standard equipment on more than 2,100 different makes of machines and is easily applied to your existing machines. Units are available in the widest variety of types, sizes, capacities and speed ratios with manual, push button or automatic control.

It's the positive answer to improved quality, higher production and lower manufacturing cost. Our experienced Speed Control Engineers will be glad to help solve your problems. Write today for the new 114-page catalog P-450A.

REEVES PULLEY COMPANY • COLUMBUS, INDIANA

Recognized Leader in the Specialized Field of Speed Control Engineering

Accurate Variable

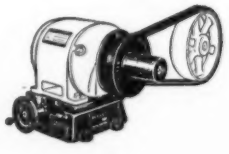
REEVES Speed Control

Gives the Right Speed for Every Job!

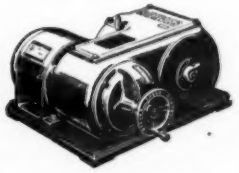
THE THREE BASIC REEVES SPEED CONTROL UNITS

VARIABLE SPEED TRANSMISSION for providing infinite, accurate speed flexibility over a wide range—2:1 to 16:1. Sizes—fractional to 87 hp.

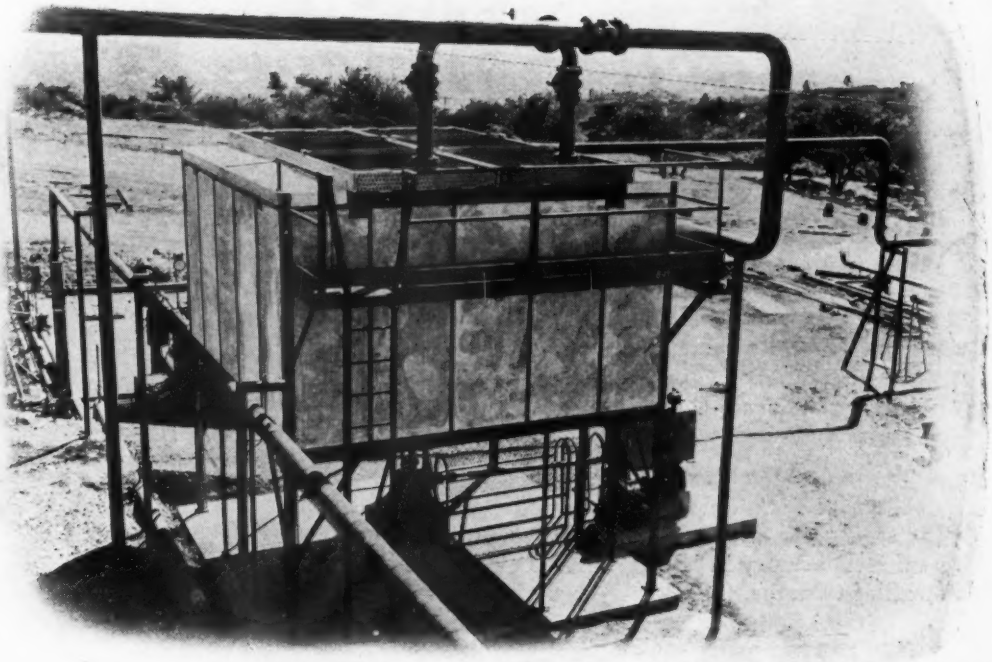
VARI-SPEED MOTOR PULLEY provides an instantly variable speed drive within 4:1 ratio for any constant speed motor. Sizes to 15 hp.



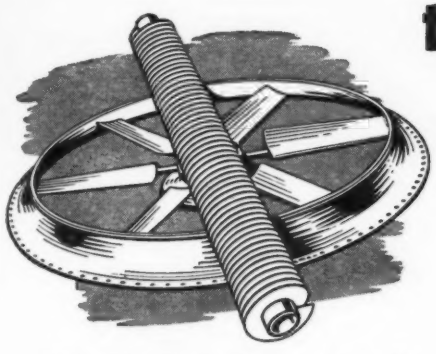
MOTODRIVE combines motor, speed varying mechanism and reduction gears in single compact unit. Speed variations 2:1 to 6:1 inclusive. Sizes to 15 hp.



Investigate FIN-FAN



the multi-service AIR-COOLED heat exchanger



This symbol denotes the principle of the FIN-FAN Air Cooled Heat Exchanger which combines the long Griscom-Russell experience in the field of heat transfer equipment and the extensive Fluor experience in air-moving systems, mechanical equipment and structures.

The important advantages of the FIN-FAN Exchanger warrants its investigation for practically every condensing and cooling service. Note these features:

PROVEN WIDE ADAPTABILITY highly successful operation under wide variety of duties—suitable for liquids, gases, and vapors at pressures up to 5,000 psi and temperatures up to 1500°F.

ECONOMICAL OPERATION independent of wind velocity or direction . . . forced draft air circulation with highly efficient fans having power saving variable pitch blades, and uniform air distribution over K-Fin cooling sections.

EASE OF INSTALLATION, OPERATION AND MAINTENANCE a complete, "package type" unit that can be installed on the ground or on top of buildings . . . no water supply equipment or piping . . . all mechanical equipment sturdy and readily accessible, with flexible operating control.

Write for complete information.

Some FIN-FAN Applications

- Exhaust steam condensing
- Engine jacket water cooling
- Gas cooling
- Still overhead and reflux condensing and cooling
- Oil cooling
- Compressed air cooling
- Solution cooling
- Refrigeration system condensing

or a combination of one or more services with the same unit

THE GRISCOM-RUSSELL CO.
285 Madison Ave., New York 17, N. Y.

GRISCOM-RUSSELL
Pioneers in Heat Transfer Apparatus

CENTRIFUGAL PUMPS FOR EVERY LIQUID

MADE for Boiler *Feed Service-*

PUMPS by "Buffalo"

"Buffalo" RR Pumps are setting performance records in hundreds of installations. They are ideally suited to the rugged boiler feed job.

These pumps are heavy-duty in every respect. Extra large bearings—extra deep stuffing boxes to hold more rings of packing—extra large rotors and shafts — accurate machining and fitting go into their construction. "Buffalo" RR pumps are hydraulically balanced—give high efficiencies of 75% and more.

Bulletin 980-B gives all specifications, sectional views, elevations and performance data. Write for your copy—see why you get peak efficiency and real life expectancy in "Buffalo" RR Two Stage and Four Stage Pumps.

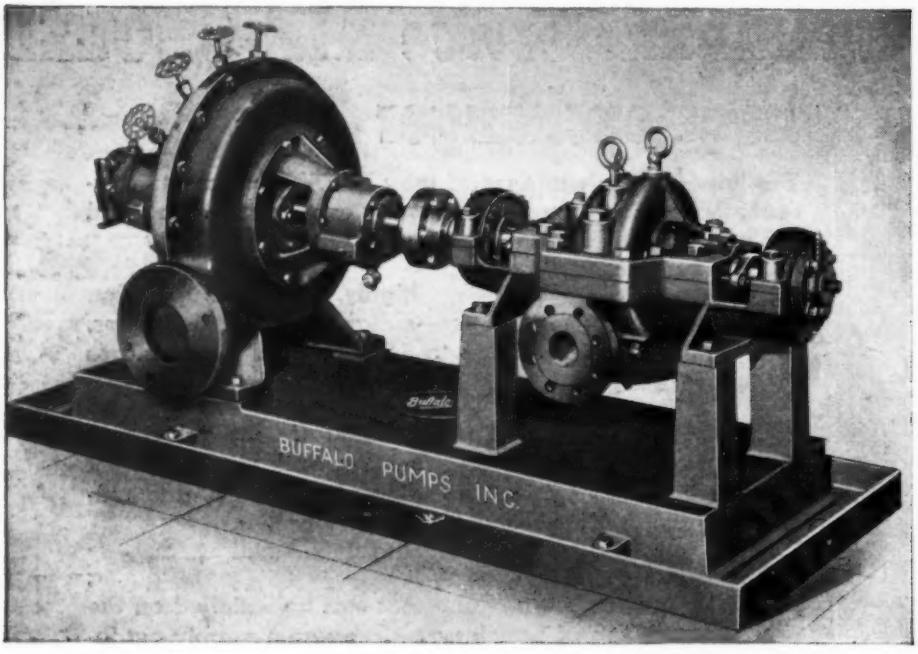
CLASS "RR" MULTISTAGE PUMPS—

—FOR CLEAR LIQUIDS, ANY TEMPERATURES

—20 TO 900 GPM CAPACITIES

—UP TO 1500' HEADS

—EFFICIENCIES ABOUT 75%



BUFFALO PUMPS, INC.

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For

★ WATER ANY TEMPERATURE

★ PAPER STOCKS (NON-CLOGGING)

★ GENERAL SERVICE

★ ACIDS

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★ SLURRY

★ CONDENSATE RETURN

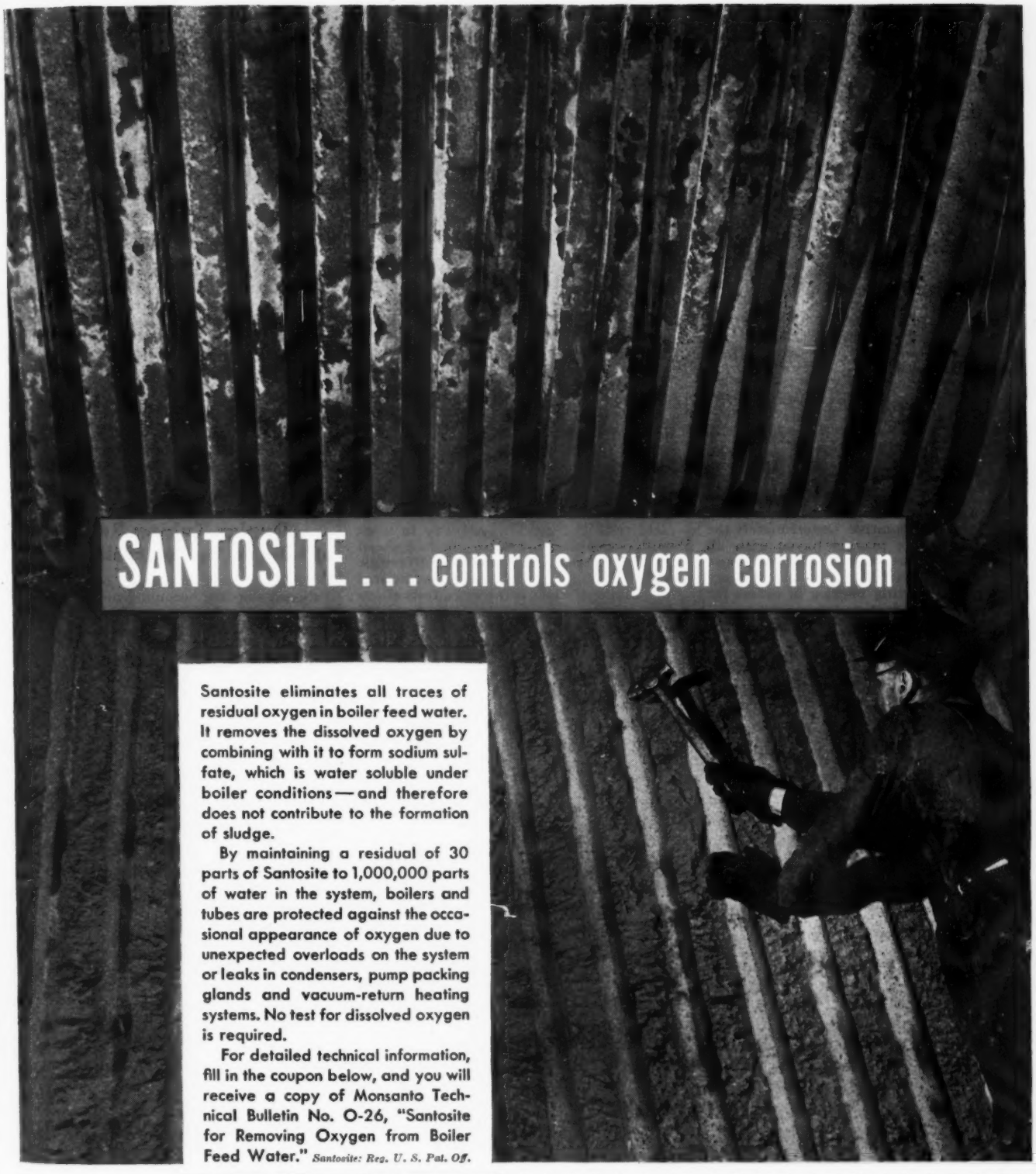
★ SUMP CLEARANCE

★ FIRE SERVICE

★ SEWAGE

★ SELF-PRIMING SERVICE

RUGGED, PRECISION CONSTRUCTION—FOR LONG LIFE



SANTOSITE . . . controls oxygen corrosion

Santosite eliminates all traces of residual oxygen in boiler feed water. It removes the dissolved oxygen by combining with it to form sodium sulfate, which is water soluble under boiler conditions — and therefore does not contribute to the formation of sludge.

By maintaining a residual of 30 parts of Santosite to 1,000,000 parts of water in the system, boilers and tubes are protected against the occasional appearance of oxygen due to unexpected overloads on the system or leaks in condensers, pump packing glands and vacuum-return heating systems. No test for dissolved oxygen is required.

For detailed technical information, fill in the coupon below, and you will receive a copy of Monsanto Technical Bulletin No. O-26, "Santosite for Removing Oxygen from Boiler Feed Water." *Santosite: Reg. U. S. Pat. Off.*

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COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Looking Ahead For 1948

Record-breaking demand for electricity for domestic, industrial and farm use during the year indicates that 1948 will be both a busy and difficult year for power generating plants. The overwhelming publicity on fuel shortages and rising prices has diverted much electric current for domestic cooking and heating which were formerly served by oil or coal. In addition, industrial activity has been surprisingly higher than expected.

The curtailment of power plant construction during the war years has in many cases brought the demand and production curves so close together that immediate expansion is imperative. Unfortunately the time element is playing havoc with all plans. Almost everyone is in the same boat and has to await his turn for delivery against a mounting backlog of orders for power plant production equipment.

On the other hand the situation in condenser tubing itself is not quite as critical as the equipment situation. Nevertheless it is advisable to place orders for tubing well in advance so that the mills will have sufficient time to make the required tubing before the equipment is available. Also there has been a growing tendency to use more corrosion-resistant alloys which are of a refractory nature and require longer time for processing.

Better Engineering

More attention is being given to the selection of condenser tube alloys for both replacement and for new equipment. Engineers are now more interested in obtaining uninterrupted production. Shutdowns are expensive from two angles: (1) loss in profitable operation; (2) mounting maintenance costs because of higher labor costs. They recognize that the first cost is less important than the complete cost obtained over long years of successful operation. The cheap condenser tube alloys can be the most expensive in terms of service hours obtained from them. This explains why condenser tube specifications call for more corrosion-resisting alloys such as Duronze IV* (arsenical aluminum bronze, alloy No. 53), aluminum brass or 70-30 cupro nickel.

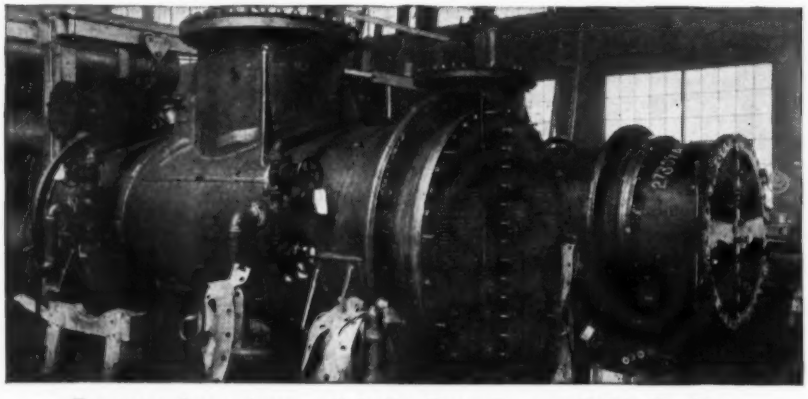
In many cases changes have resulted from the record of excellent performance of sample tubing which had been under observation for several years. This indicates the real benefits which are obtained by working closely with metallurgical laboratories such as our own. We are great believers in field tests and are always ready to work with power plant operators who look ahead to the time when they will have to retube their condensers or will put in additional installations. Field and service tests eliminate guesswork as samples of various alloys are actually operating under existing water and operating conditions. We have learned from many years' experience that water conditions are generally changing for the worse from year to year. Increasing population is responsible for growing pollution from industrial wastes and sewage.

Duronze IV Finding Wider Uses

It is interesting to note that Duronze IV is also finding greater use in the oil refining industry because of the similar problem of using circulating water which continues to become more and more corrosive. This industry also has problems of continuous operation and high maintenance costs. This tendency to switch into more corrosion-resisting alloys is a healthy one as it definitely shows that engineers recognize the great losses which result from corrosive attack and are taking steps to resist it.

In the marine field most of the demand is for the replacement of condenser tubing which has been installed during and before the war. Higher operating speeds and greater efficiency call for alloys which are able to withstand destruction from air impingement and from erosion. There have been a number of changes from Admiralty brass to arsenical aluminum brass (alloy No. 54), where impingement corrosion has caused the failure of Admiralty tubes.

The problem of corrosion requires much study and patient research. Bridgeport's laboratory will be glad to help you by suggesting the alloy which will best serve. Much information on the properties and applications of condenser tube alloys is found in Bridgeport's 120-page Condenser Tube Manual which will be sent upon request on company stationery.



Two-pass surface condensers made by Ross Heater Company, Buffalo, New York.

Duplex Tubing Reduces Failures, Lowers Maintenance

Power plant engineers on land and aboard ship are becoming more and more concerned with the operation and maintenance of refrigeration equipment. The use of refrigeration for food preservation and quick-freezing is increasing. Of course, refrigeration is also widely used in the food and beverage business and in industry for the handling and storage of special materials, as well as in the manufacture of synthetics, plastics, chemicals and pharmaceuticals. Refrigeration systems usually involve considerable tubing which is called upon to handle many types of refrigerants —corrosive liquids and gases.

Ammonia refrigeration, which is widely used for meat-packing, artificial ice-making and quick freezing, as well as in the chemical and synthetics industries, involves corrosive ammonia gas on one side of the tubing and water or brine on the other. Although steel or iron pipe stands up well on the ammonia side, in time it fails from rusting on the water or brine side. For this application, Duplex Tubing, consisting of steel to the ammonia side and copper or brass to the water side, is growing in popularity. The two tubes are drawn together in such a way that excellent heat transfer results. It has been found that Duplex Tubing lasts much longer than steel tubing for ammonia refrigeration systems.

In some refrigeration systems, there is corrosion plus the problem of taste or color contamination of the product. A methyl chloride system is a good example. Here, Duplex Tubing can be used with copper to the refrigerant and aluminum in contact with the fruit juice, food product, chemical or drug.

Duplex Tubing is available in many combinations: Admiralty, Aluminum Brass, Copper, Cupro Nickel, Aluminum Bronze, Duronze IV, Muntz Metal, Naval Brass, Red Brass, or Yellow Brass in combination with aluminum, monel, nickel, low carbon steel or stainless, either inside or outside.

*U. S. Pat. No. 2,093,380

BRIDGEPORT BRASS

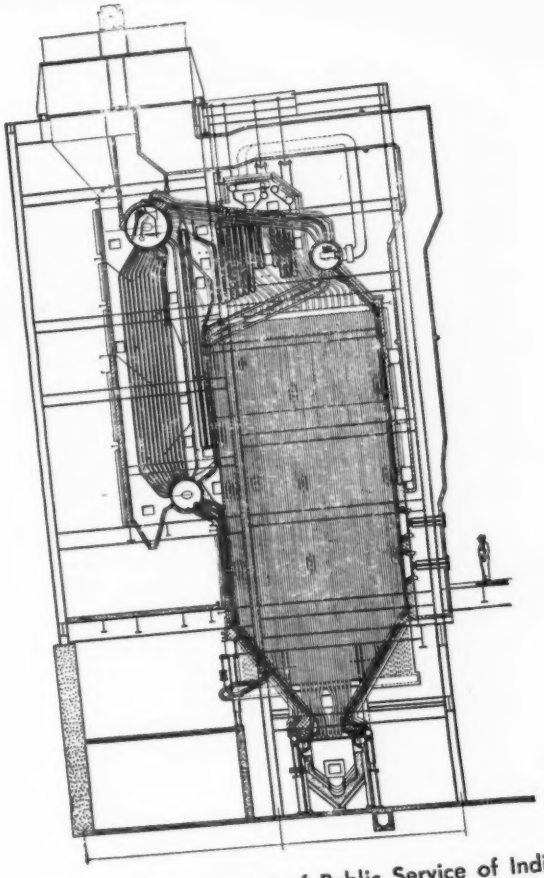
BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • ESTABLISHED 1865

Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal

ENGINEERING PROGRESS REPORT #17

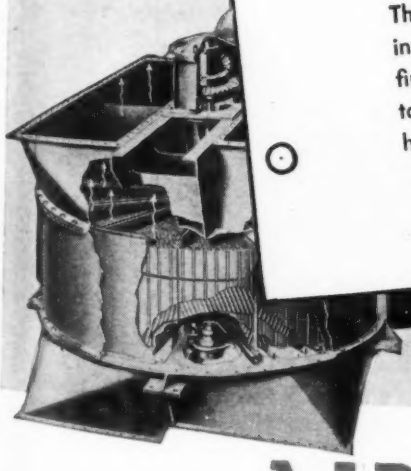
LJUNGSTROM AIR PREHEATER

TWO NEW 400,000-LB. STEAM GENERATING UNITS FOR PUBLIC SERVICE OF INDIANA



The Edwardsport, Indiana station of Public Service of Indiana will install two 400,000 lb. per hour boilers. These two powdered-coal-fired boilers will be built by Riley Stoker Corporation. Each unit is to be equipped with one Ljungstrom Air Preheater, delivering pre-heated air at 605 F., with 335 F. exit gas temperature.

Sargent & Lundy of Chicago, Ill. are the consulting engineers.



THE
AIR PREHEATER
CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, N. Y.

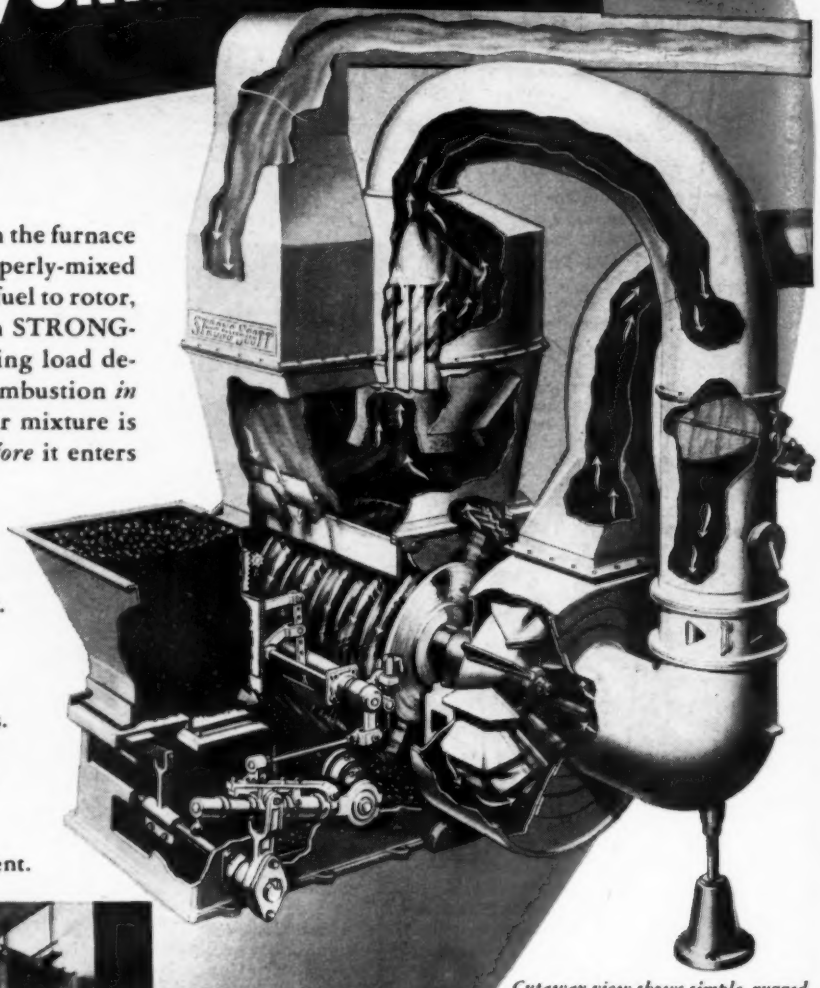
STRONG SCOTT UNIT PULVERIZER assures . . .

CONSTANT, UNIFORM FIRING

Complete and continuous combustion in the furnace depends upon a constant supply of properly-mixed fuel and air. Automatic underfeeding of fuel to rotor, and flexible fuel-air mixture controls in STRONG-SCOTT Unit Pulverizers, meet fluctuating load demands quickly and easily. Complete combustion *in suspension* is assured because the fuel-air mixture is properly proportioned and diffused *before* it enters the burner.

OTHER ADVANTAGES

1. Requires minimum maintenance.
2. Has simple design, few wearing parts.
3. Built rugged and strong.
4. Permits maximum flexibility.
5. Uses non-clog underfeed method.
6. Can be adapted to varying conditions.
7. Operates efficiently, economically.
8. Burns soft coal, or by-product pitch.
9. Pulverizes by air-swept attrition.
10. Requires no magnetic separator.
11. Burns fuel with greater moisture content.



Cutaway view shows simple, rugged design of STRONG-SCOTT Unit Pulverizer. Typical installation shown at left.

WITH 51 YEARS EXPERIENCE in manufacturing—23 in the combustion engineering field—STRONG-SCOTT Unit Pulverizers are guaranteed for *dependability, service and performance*. Repeat orders from satisfied customers account for over 40% of our business.

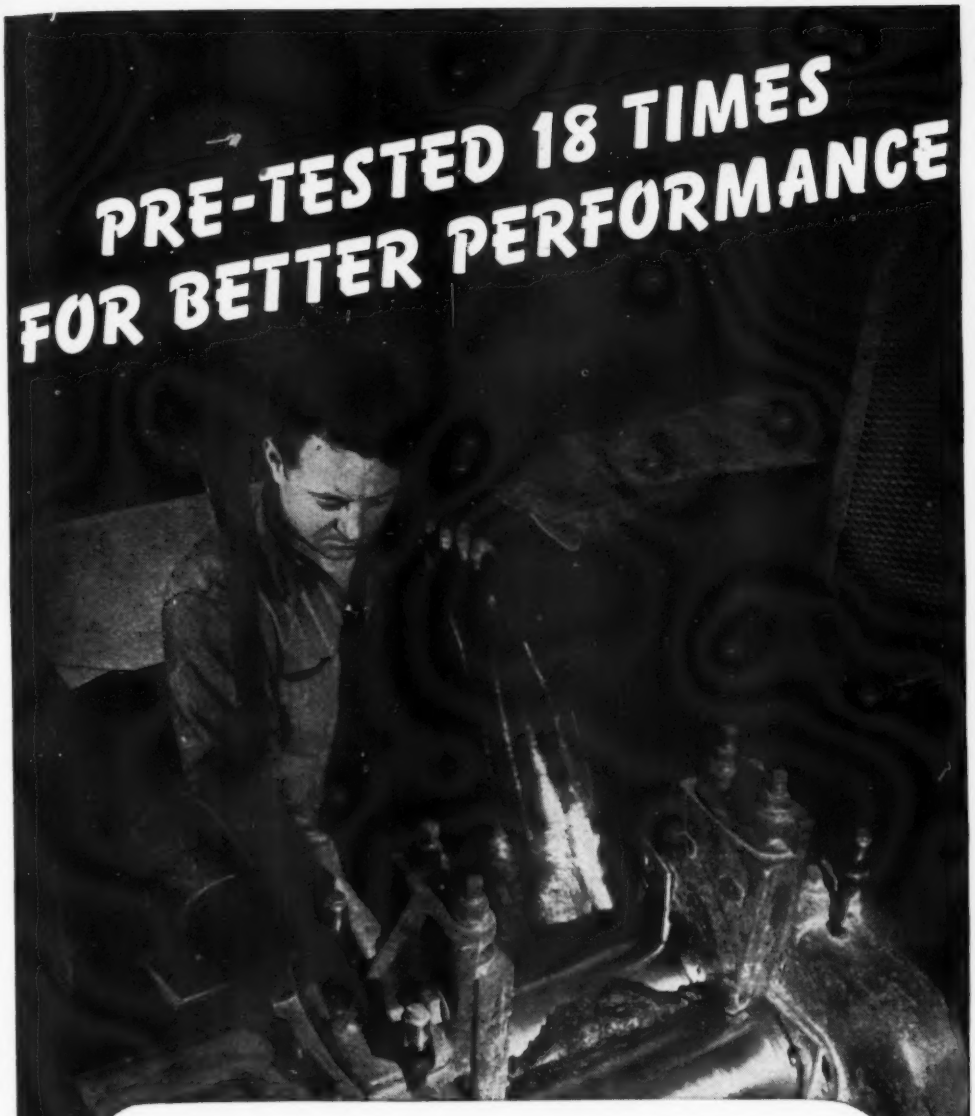
There are hundreds of installations in over 200 American cities and several foreign countries. Visit one of these in your vicinity and see a STRONG-SCOTT Unit Pulverizer in operation. "Seeing is believing."

WRITE TODAY for Bulletin 341 for complete information. Names of users in your vicinity furnished on request.

The STRONG-SCOTT Mfg. Co.
455 TAFT STREET N. E. • MINNEAPOLIS 13, MINN., U. S. A.

STRONG SCOTT
UNIT PULVERIZER

PRE-TESTED 18 TIMES FOR BETTER PERFORMANCE



The Quaker testing laboratory is on the job day and night, maintaining top quality . . . continuously working in advance of industry's demand for the best in belting, hose, packings.

Each batch of rubber is carefully compounded and mixed in miniature masticators shown above. After mixing, compounds must pass a series of severe tests simulating actual working conditions. That's your assurance of peak performance when Quaker products are on the job. Strict laboratory control, coupled with 62 years of development know-how keep Quaker products out front for efficient operation.

And for quick, reliable service, call your nearest Quaker distributor. He and the Quaker sales engineer form an efficient team, ready to offer the *right* recommendations on Quaker pre-tested belting, hose, packings . . . for all purposes.

QUAKER RUBBER CORPORATION

PHILADELPHIA 24, PA. • New York 7 • Cleveland 15 • Chicago 16 • Houston 1
Western Territory
QUAKER PACIFIC RUBBER COMPANY • San Francisco 5 • Los Angeles 21

QUAKER RUBBER PRODUCTS

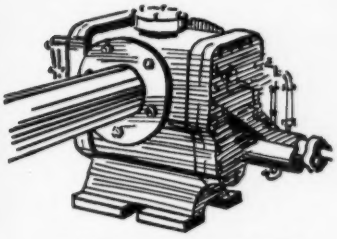
custom made for every industrial use

QUAKER PACKINGS IN INDUSTRY

Quaker products are tried, tested, proved for better performance in industry everywhere.

PUTS THE FREEZE ON LEAKS

Upon recommendation of a Quaker sales engineer, a midwest creamery installed Quaker Daniell's P.P.P. Packing on their ice machines. Result? The creamery obtained the tight sealing action so essential, saving time, cutting costs. There are no leaks here!



"TRIPLE THE SERVICE"

Here's how one large eastern plant eliminated an asphalt pump packing problem. "...The longest service ever received from other packings was 30 days, but Quaker Copperpac and #175 Ebonite packing have been in use for over 3 months and still going strong."

SAFETY FIRST WITH PETRO-PAK

One well-known eastern refinery found the right answer for packing 4" stuffing boxes when it put Quaker #1675 Petro-pak to the test. Specially-designed for the petroleum industry, Petro-pak passed the test with flying colors . . . provided safe, leak-proof sealing action.

One of a series *of messages to help you increase your understanding of business paper advertising, and its effect on your business.*

Why you and your advertising manager are partners

FROM WHERE YOU SIT, advertising may look like the "glamour department" of your company—necessary, of course, but pretty far removed from the hard-headed realities of the production line.

But take a closer look. In one respect, the advertising manager's job bears a striking resemblance to your own.

You're production-minded. You're concerned with anything that will improve plant procedures, speed up assembly time, prevent waste, and reduce the manufacturing cost per unit.

And that is precisely where you walk arm-in-arm with your advertising manager. Because he thinks the same way about the *manufacture of a sale.*

The whole process of selling and distribution are his assembly line. And every time he can reduce the unit cost of a sale by so much as a few cents, he increases your company's chance to show a profit.

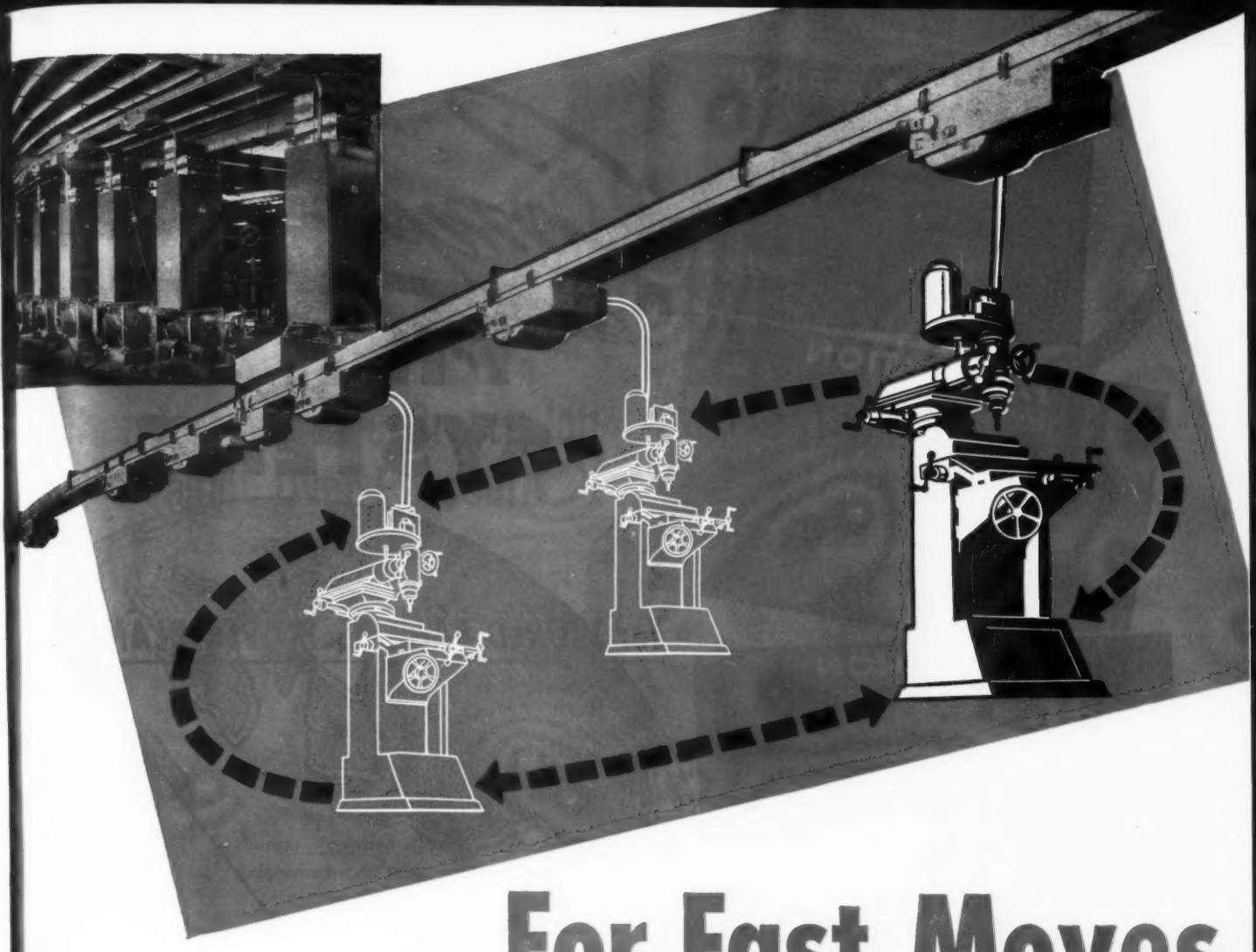
Ask him for a definition of advertising, and he will probably tell you that it is simply *mechanized selling,* a machine that multiplies the productive capacity of the sales force — seeking out prospects, arousing their interest, creating a preference for the things your company makes.

And when it is concentrated among the hand-picked readers of business papers, advertising becomes the most efficient machine this partner of yours has found for lowering the cost of producing a sale.

What are the ten ways to measure the results of your business paper advertising? You'll find the answers in a recent ABP folder, which we'll be glad to send you on request. Also, if you'd like reprints of this advertisement (or the entire series) to show to others in your organization, you may have them for the asking.

POWER

is one of the 129 members of The Associated Business Papers, whose chief purpose is to maintain the highest standards of editorial helpfulness—for the benefit of reader and advertiser alike.



For Fast Moves

Relocate machines with no delays for rewiring

Power can be taken off wherever needed with this convenient, flexible and economical distribution system.

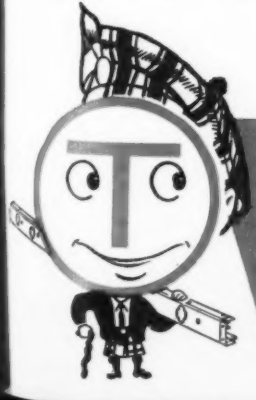
Power where you want it — with Trumbull FLEX-A-POWER Plug-In Busways—gives you maximum flexibility in machine arrangement without the cost and nuisance of rewiring each time you change the layout.

With FLEX-A-POWER Plug-In Busways covering your whole plant, you can move a machine or a whole line of machines with no interruption of power. Convenient outlets every 12 inches permit plug-ins *right at the load.*

Even when major changeovers require moving an entire department, the FLEX-A-POWER system can be moved along, too — dismantled, removed and reinstalled quickly, with practically 100% use of all materials.

That's because every part of a Trumbull Busway System is prefabricated, which of course reduces original installation and construction costs. FLEX-A-POWER is stocked in standard 10 foot lengths and is available in capacities from 250 to 1000 amp. with all necessary fittings and accessories.

Send for Bulletin. THE TRUMBULL ELECTRIC MANUFACTURING CO., Plainville, Conn. Other factories at Norwood, Ohio • San Francisco • Seattle • N. Hollywood. Sales offices and representatives in all important cities.



The OVERHEAD that pays for itself in Cost Reduction

TRUMBULL (T) ELECTRIC

Flex-a-Power

Complete PIPING SYSTEMS

for WORLD FAMOUS POWER PLANTS

In every major industrial area there are great power plants having piping systems whose efficient operation was "built in" by expert P. P. & E. prefabrication.

Prefabrication by Pittsburgh Piping and Equipment Company starts with the blueprint—materials are selected on the basis of conditions to be met, and completely erected by skilled craftsmen.

When you place your *complete* job in the hands of P. P. & E.—you utilize to the utmost extent the knowledge we have accumulated through almost half a century of producing piping systems for the world's greatest power plants.

Ask our nearest representative for further information.

Pittsburgh Piping

AND EQUIPMENT COMPANY

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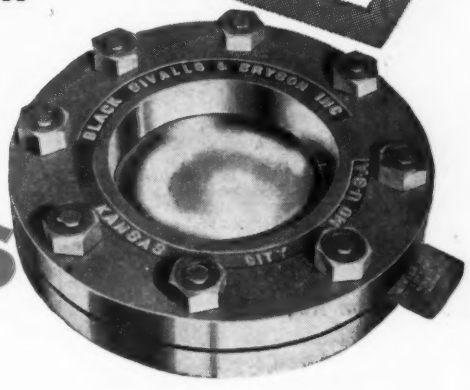
Woolworth Building, New York
Chamber of Commerce Bldg., Indianapolis
Book Tower, Detroit
525 Market Street, San Francisco
315 West 9th Street, Los Angeles
Peoples Gas Building, Chicago
Public Square Building, Cleveland
10 High Street, Boston
Heights State Bank Bldg., Houston
Whitehead Building, Atlanta

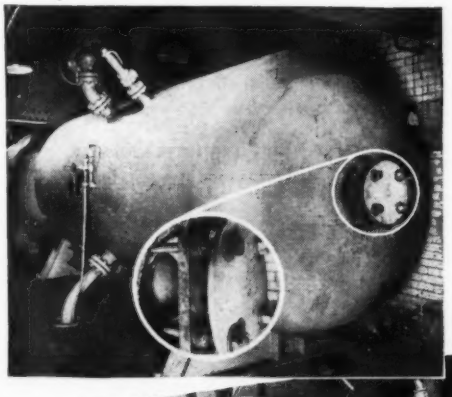
Are You Risking Losses from

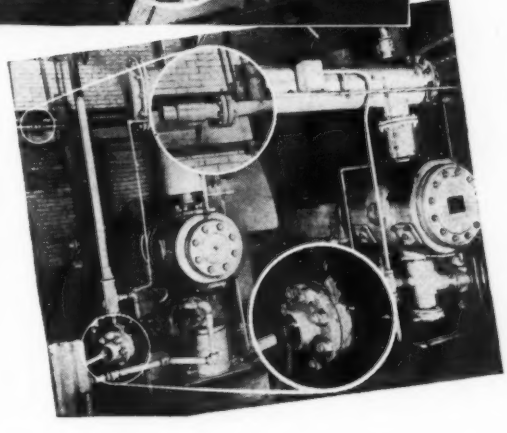
COMPRESSED AIR EXPLOSIONS?

There's Complete Protection Against Over-Pressure in BS&B SAFETY HEADS



● Don't scoff . . . compressed air systems do explode! Insurance company records offer proof. Vaporized oil-air mixtures touched off by a fleck of hot carbon, leaky discharge valves allowing hot air to be drawn back into the system, clogged intake filters overheating compressors . . . all these mean trouble. Inter and after coolers eliminate many dangers . . . relief valves handle normal pressure rises. But it takes SAFETY HEADS for that positive margin of safety. Yes, sir, SAFETY HEADS act instantly, even to high speed pressure waves! Provide full, pipe-size unrestricted relief opening.





Thousands of Installations Prove Effectiveness of SAFETY HEADS

No other pressure relief device offers such complete protection with such economy. No other device can approach the relief capacity of a SAFETY HEAD in a given diameter. The simple rupture diaphragm bursts in tension at pre-determined pressure and temperature. You'll be amazed at their versatility . . . 5 to 25,000 psi . . . a size for every need. Quickly and easily replaced.

Your plant, like the Central New York Power Plant at Oswego, pictured at left, can profit from the protection of SAFETY HEADS. Write today for complete information and specifications. Address the Special Products Division, Black, Sivalls & Bryson, Inc., Power and Light Building, Kansas City 6, Missouri.

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HAHN PRODUCTS FOR ECONOMY & EFFICIENCY

PIPE-LINE or PNEUMATIC CONVEYORS
FOR ASHES AND FLY-ASH

"Most economical in steam-consumption and maintenance." Design of every part, fitting, etc., based on our experience of 25 years with the successful manufacture and operation of conveyors of this type and on our full appreciation of their special requirements.

We also specialize in improving existing conveyors through our superior fittings and frequently through rearrangement of present layouts.

CAST IRON SECTIONAL ASH TANKS, COAL BUNKERS, BINS, HOPPERS and SILOS

Durability combined with our exclusive discharge-efficient and self-clearing designs, preventing arching, packing and spontaneous combustion in case of coal bunkers and also obviating the necessity of hazardous trimming.

MECHANICAL SOOT BLOWERS FOR FIRE-TUBE BOILERS of ALL TYPES

Fixed nozzle centered to each tube. No cutting of tube-sheet. No moving parts in hot boiler. All tubes in boiler blown with four successive puffs of steam or air in about one minute. Perfect soot-removal from each tube END TO END.

Complete Data on Request

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(formerly Hahn Engineering Company)
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REPLACE GASKETS QUICKLY . . . EASILY

Williams FLANGE-JACKS, formerly manufactured by T. J. Persson Co., Bloomfield, N. J., eliminate long, costly shut-downs for gasket replacements. Ease of operation permits speedy separation of flanges regardless of location. Operating with a minimum of effort even in tight, cramped quarters, FLANGE-JACKS exert tremendous pressure evenly and smoothly . . . without shock along the pipe line. Bolt holes are securely held in perfect alignment and flange faces cannot be damaged. See your distributor for trade discounts on these fully patented tools.

J. H. WILLIAMS & CO.
BUFFALO 7, N. Y.

Standard No. 20 $24.00 pr.
Giant No. 30 $48.00 pr.

SOLD IN PAIRS

WILLIAMS **Flange-Jacks**

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LUBE MEMO

Easy way to end sticky valve trouble

Sticky gum on our valves

Ex. valve on #1 isn't closing —loss of compression and power.

Nelson brags RPM DELO Oil keeps his valves clean as a whistle.

Nelson says compounds in RPM DELO Diesel Engine Lubricating Oil keeps valves free 3 ways:

1. Anti-oxidant stops gum formation
2. Metal adherent keeps oil film on stem—prevents wear.
3. Detergent cleans away carbon deposits.

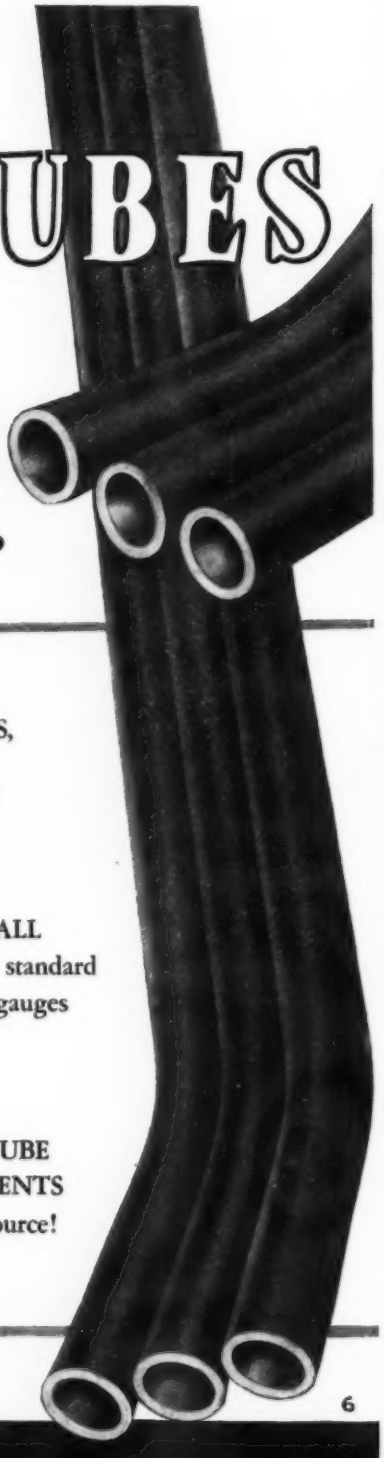
Mon.—lube change due—get RPM DELO Oil

DIESEL ENGINE RPM DELO LUBRICATING OIL

STANDARD OF CALIFORNIA • San Francisco, Calif.
THE CALIFORNIA COMPANY • Denver, Colo.
THE CALIFORNIA OIL COMPANY • New York
STANDARD OF TEXAS • El Paso, Texas

for TUBES

call on B.T.A.



BENT TUBES, accurately fabricated!

TUBES OF ALL SIZES — in standard and extra gauges

ANY TYPE TUBE REPLACEMENTS from one source!

6

BOILER TUBE CO. OF AMERICA

McKEES ROCKS, PA. (Pittsburgh District)

PITTSBURGH · CHICAGO
FRED S. RENAULD & CO., LOS ANGELES

Are you equipped to hold your job?—to get a new one?

The men who are keeping their jobs today—who are not feeling the whip of competition—are those who have kept one jump ahead of their jobs. They are the men who are equipped with a thorough-going and growing knowledge of the business they are in.

It works in the power plant field as well as in any other. Some men fit themselves to do a little more than their job calls for. They fit themselves to do a little more than the other fellow. They make a steady effort to equip themselves with the best kind of job insurance there is—KNOWLEDGE.

How about you? Do you know how quickly knowledge will pile up—how quickly you will become more valuable—if you spend a few minutes a day, regularly studying sound books like the McGraw-Hill Library of Power Plant Practice? Do you know how easily it can be managed, paying only a few cents a day, while you use the books?

Thousands of men have followed this plan to win advancement or to make their jobs safe. You can too. Read about this Library and our Free Examination Offer. Then send the attached coupon to us today.

POWER PLANT PRACTICE

(6 volumes—2,477 pages, 2,404 illustrations)

The Library of Power Plant Practice is the standard of the power plant field. It is accurate — it is thorough — it is complete. It is the result of years of experience with power plant problems. The man who has it has the best. The Library covers the whole field—nothing is omitted. The solution of every problem is plainly worded or explained with a clear illustration. The little stickers and the big troublesome problems are all worked out in advance for you. There can be only one result from studying these books a few minutes each day — more money in your pocket.

No books dealing with the work of the power plant man were ever so complete — so authoritative — so practical in text and illustrations as these. The man who puts this set of books into his library can do so knowing that he has the utmost in power plant books—a set that will give him in language he can understand, all the information he needs in order to get ahead in his work.

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These books are written in everyday easy-to-understand language. They are written to help the man on the job. It is just as if the author were working in the plant by your side and giving you the benefit of his vast knowledge, man to man. There is no bunkum in this Library, nor is it cluttered up with impractical theories. It is a Power Plant Library FOR POWER PLANT MEN.

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Fill in and mail the coupon below and we will send you the six volumes of the Power Plant Library for 10 days' examination. If you decide to keep the books after examining them, just send $3.50 and then $3.00 a month until the total low price of $18.50 has been paid. See the coupon below for details Send it Now and HOLD THAT JOB!

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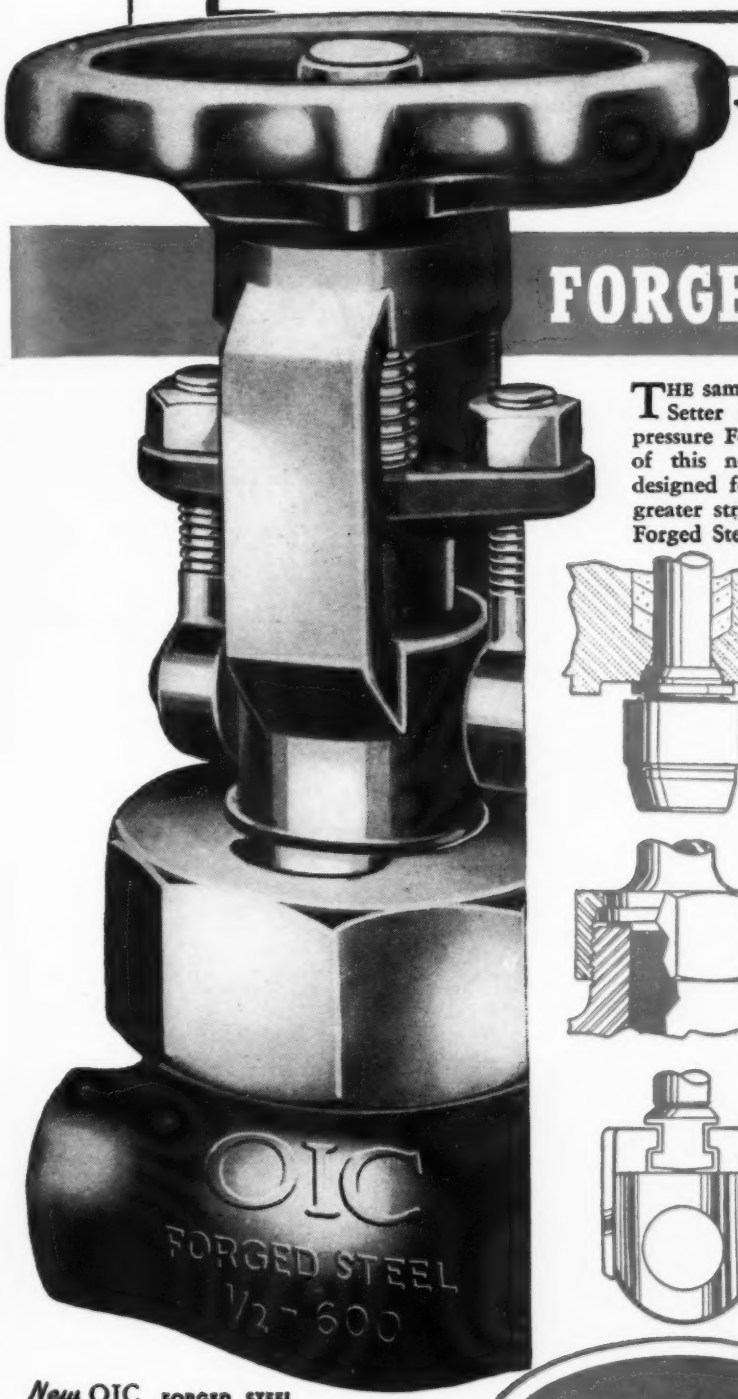
OIC

PACE-SETTER IN VALVES

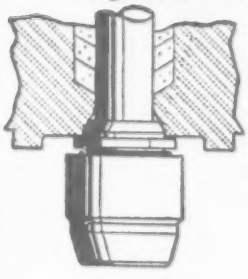
Announces

A NEW LINE OF

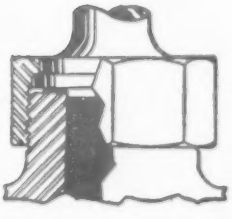
FORGED STEEL VALVES!



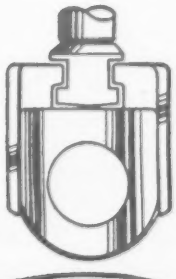
THE same superior quality that earns OIC the title of "Pace-Setter In Valves" is now available in OIC 600-pound pressure Forged Steel Valves. You'll find bodies and bonnets of this new OIC line precisely machined from carefully designed forgings . . . ample wall thicknesses maintained for greater strength and safety . . . in all types and sizes, OIC Forged Steel Valves exceed the accepted standards.



Mirror-like finish on mating back seat surfaces insures a positive, leak-proof seal when the valve is in the full open position. This handy feature permits complete removal of the packing without disturbing the flow and without danger of leakage and injury to the operator.



The stout union bonnet ring is machined from rolled steel. The octagonal design provides a greater number of wrench-grip positions and maintains ample cross-sectional area for maximum strength without excessively protruding corners. All bonnet studs and nuts are of heat-treated material — another OIC quality feature.



OIC Forged Steel Gate Valves are provided with a rugged T-head-and-slot connection between stem and disc. This connection is accurately machined to close tolerances with proper clearances allowing the disc to adjust itself to the seats without binding, thereby insuring long, dependable, trouble-free service.

New OIC **FORGED STEEL**
VALVE CATALOG No. 48F5 NOW READY
It's made to fit inside your big 248-page OIC Catalog. You'll have *all* the valve information you need right at your fingertips. For your free copy, just write, giving your name, firm, and address to The Ohio Injector Company, Wadsworth, Ohio.

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FEEDWATER HEATERS

Deaerating and Non-Deaerating

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The Hoppes Mfg. Co., Inc.

Established 1881

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AS QUICK AS A FLASH YOU CAN KNOW THE EXACT MEASUREMENT OF YOUR VALUABLE STORED LIQUIDS With **LIQUIDOMETER** *Tank Gauges*

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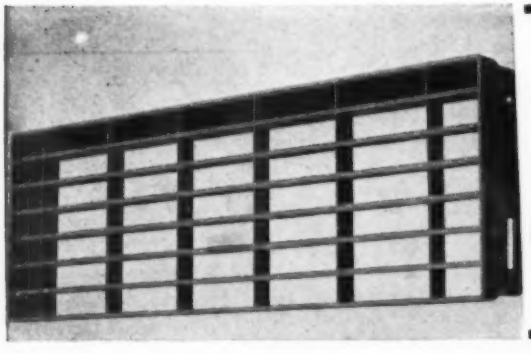
THE LIQUIDOMETER CORP.
39-16 SKILLMAN AVE., LONG ISLAND CITY, L.N.Y.

Nosing Bar has Dual Advantages on MITCO SHUR-SITE TREADS

Here's a patented, double-value feature of Hendrick Mitco Shur-Site Treads. The heavy, flanged nosing bar makes each step distinctly visible, for accident prevention, and it also provides additional strength at the point of heaviest loading. Shur-Site Treads have all the other Mitco constructional advantages, including non-slipping, non-clogging surfaces.

Write for detailed information on Mitco Shur-Site Treads, Mitco Open Steel Flooring and Mitco Armorgrids.



SEE OUR CATALOG IN SWEET'S

Perforated Metals
Perforated Metal Screens
Architectural Grilles
Mitco Open Steel Flooring,
"Shur-Site" Treads and
Armorgrids

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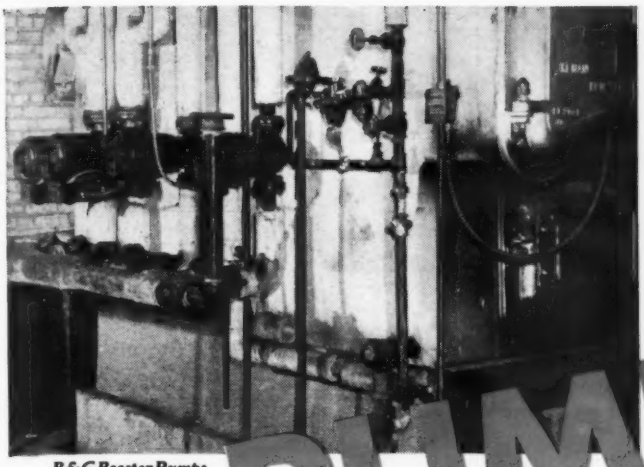
Manufacturing Company
46 DUNDAFF STREET, CARBONDALE, PENNA.
Sales Offices In Principal Cities



B&G Booster Pumps on zoned forced hot water heating system in industrial plant.

B & G Pumps in ice cream manufacturing plant.

PUMPS

FOR HEATING SYSTEMS AND INDUSTRIAL USE

...by the makers of ~~Hydro-Flo~~ PRODUCTS

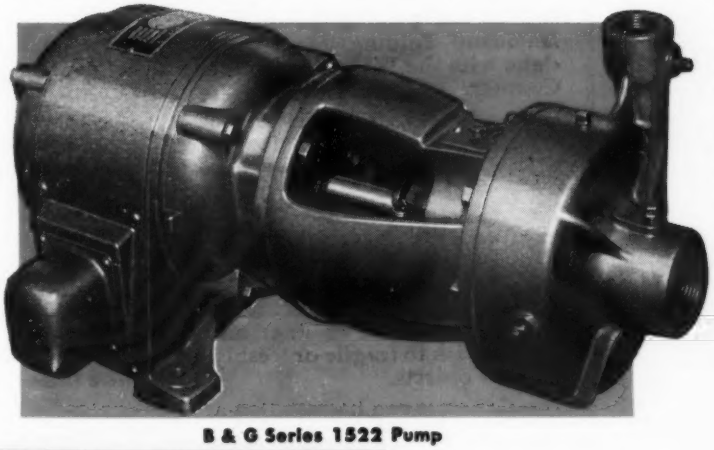
You can sum up the reasons for the universal acceptance of B & G Pumps in a single sentence—"Sound engineering, backed by modern manufacturing methods capable of translating good design into fine product."

When you specify "B & G" you can be sure that full value will be delivered, both in long service life and in low cost operation.

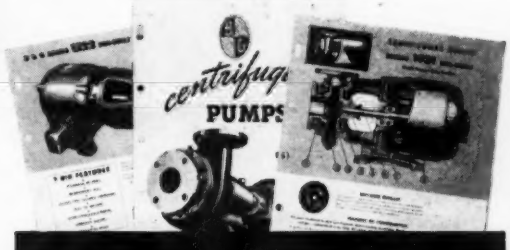
For example, you have only to watch a B & G Series 1522 Pump circulating a thick mixture of oil and metal chips to realize that it is a unit which can really handle difficult pumping jobs. Its outstanding features include—a Mechanical Seal instead of a stuffing box—Standard Motors—Spring-type Flexible Coupling—Interchangeable Parts—Compact Design—Easy Servicing.

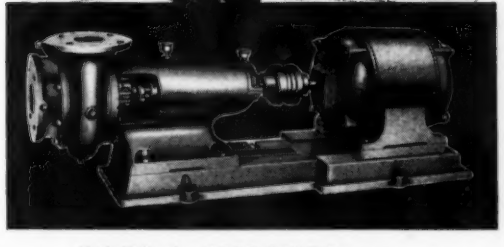
All other models of B & G Centrifugal Pumps are likewise known for design features and precision workmanship which satisfy the most critical engineers and operating men.

Send for descriptive literature.



B & G Series 1522 Pump





B & G Series 1510-1515 Pump

Base-mounted, flexible coupled units with semi-open or enclosed impellers. Accurate machining and mechanical balancing assure quiet operation and peak efficiency.

B & G Booster

B & G Boosters have a nationwide reputation for completely dependable operation in forced hot water heating systems. Over a half million Boosters have been installed to date in buildings of every size and character.

B&G *Hydro-Flo* Products also include Heat Exchangers . . . Refrigeration Components . . . Oil Coolers . . . Water Heaters . . . and Forced Hot Water Heating Equipment. Write for literature.

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THE NYLON GAUGE MOVEMENT—another revolutionary new development by Ashcroft.

Exhaustively field-tested and employing well established engineering principles, this new movement outwears and outperforms any other gauge movement even under the most severe conditions of vibration and pulsation.

NYLON, with its low coefficient of friction, high resistance to shock loading, and its vibration absorbent characteristics, far surpasses the wearing qualities and corrosion resistance of anything heretofore available as a material for pressure gauge movements.

Watch for the announcement. Ashcroft Duragauges will soon be available with the NYLON movement.

Stocked and sold by leading Distributors everywhere . . . When you order gauges, insist on ASHCROFT . . . Write for booklet.

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MANNING MAXWELL & MOORE INC. M&M TRADE MARK

ASHCROFT *Gauges*

A Product of

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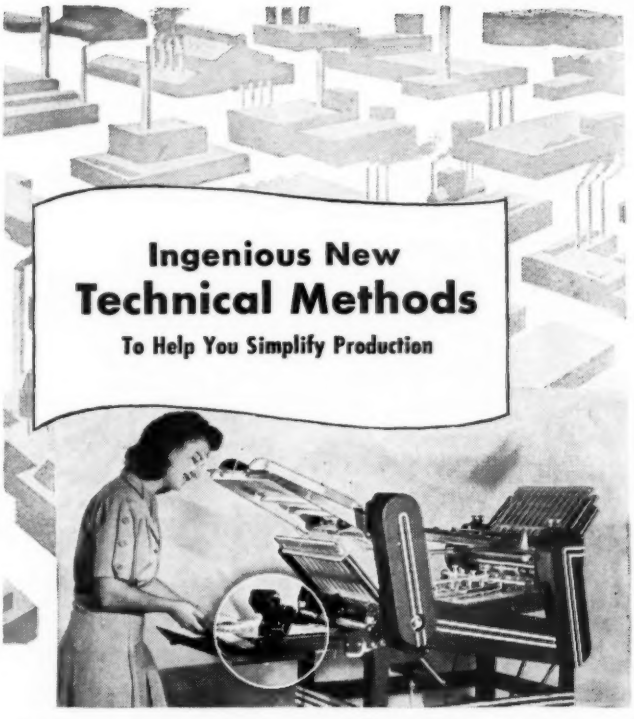
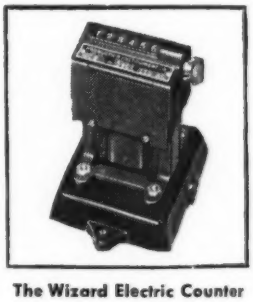


Ingenious New Technical Methods

To Help You Simplify Production

Instantaneous Production Control With Improved Electric Counter

Accurate, up-to-the-minute counting of the production on this Davidson Folding Machine is done with the WIZARD Electric Counter.



The Wizard Electric Counter

New opportunities for more efficient production and elimination of over-run waste are created by WIZARD Electric Counters. These electrically-operated devices count any object or motion that will operate a switch, relay or photo-electric unit. Objects can be counted photo-electrically without physical contact and without risk to fragile or freshly-painted objects.

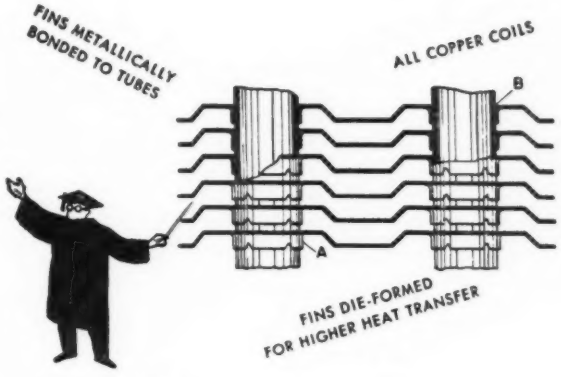
The Counters can be installed at any distance from the switch or Photo-electric unit where the count originates. Or, they can be mounted on panels in the Production Department and arranged so that a production supervisor can maintain up-to-the-instant counts of all operations throughout the entire plant.

You can also count on chewing gum to help employee's on-the-job efficiency. Chewing gum helps relieve tension—keeps the throat moist—and prevents "false thirst" yet leaves the hands free for work. That's why more and more plant owners are making Wrigley's Spearmint Gum available to everyone.

Complete details may be obtained from Production Instrument Company, 710 West Jackson Boulevard, Chicago 6, Illinois.

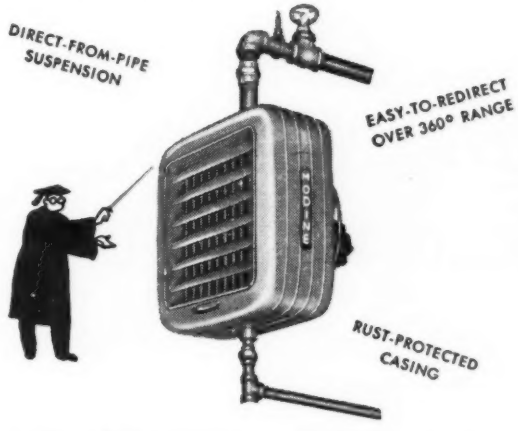
AC-52

Here's Today's Lesson on Tomorrow's Unit Heaters!

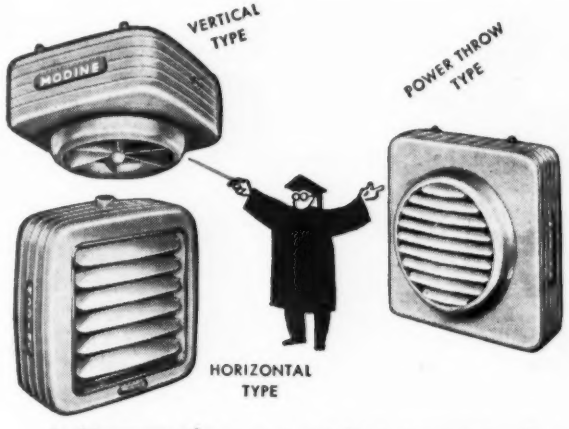


1. Consider *construction*—Modine gives you a metallic bond which permanently seals the flanged collars of fins (A) to tubes (B) . . . prevents corrosion . . . assures you extra years of high heat transfer efficiency, lasting performance satisfaction.

2. Take a peek at *performance*— Modine scientifically planned heat distribution gives you heat where and when you want it. You get the exact temperatures you want because Modine air velocities and air volumes are carefully related to your needs.



3. Remember *suspension*—Patented center supply and return connections mean you can suspend Modine Horizontal Units directly from the supply line with savings up to $10 per unit. Complete safety. No expensive supports. No extra labor costs.



4. Measure the *need*—Modine's integrated unit heater line gives you 3 types with 47 basic capacities. 1) Horizontal Type for general applications. 2) Vertical Type for overhead use. 3) Power Throw Type for special high velocities.

MORAL: Move Ahead with Modine Quality!

When you buy Modine, you buy the quality unit heater that's years ahead in engineering and design. Built to meet almost all the space heating requirements of modern industrial and commercial buildings, Modines give you modern beauty, plus the finest in modern performance and construction. Get all the facts from Modine's representative listed in the "Where-to-Buy-it" section of your phone book. Or send in coupon at right.

MODINE MANUFACTURING CO.
1512 Dekoven Ave.
Racine, Wisconsin

YES! I want all the facts about Modine's integrated Unit Heater Line. Please send me complete information.

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Modine UNIT HEATERS

Hi-Pressure Gage Glasses

Round, Tubular and Flat Type

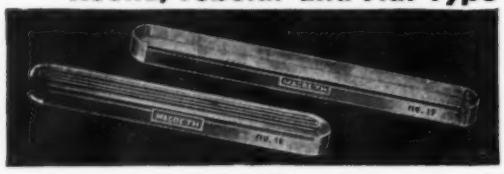

Fig. 12

RUBBER GAGE GLASS GASKETS
Series 750 . . . All Sizes

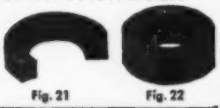

Fig. 21 Fig. 22

Other Ernst Specialties
are given in Catalog No. 48-P

GAGE GLASS ILLUMINATORS
NEW PLASTIC GUARDS
SIGHT FLOW INDICATORS
SPLIT-GLAND WATER GAGE
STEEL GAGE VALVES
FLAT GLASS INSERTS
ALL IRON GAGES
HIGH & LOW ALARM COLUMNS
MICA SHIELDS AND GASKETS
AND OTHER HELPFUL TIPS ON
BOILER ROOM SAFETY

Inclined for Better Visibility
Standard Type—Offset Adjustable Inclined Gage Fittings
Fig. 47

Fig. 13
Leakless Super Try Cocks, Bronze and Forged Steel Construction

Send for Catalog 48P

Ernst WATER COLUMN & GAGE CO.
LIVINGSTON, N. J. LIVINGSTON 6-1400

New-Type Preventive Stops Rust Effectively

EVANSTON, ILL. Industry's ancient enemy, rust, can be licked at low cost with Rust-Oleum. It's highly resistant to rain, snow, dampness, acids, etc. Rust-Oleum gives quick, lasting protection for all rustable metal surfaces — indoors or out.

Rust-Oleum forms a tough, enduring coating that protects roofs, tanks, machinery, pipes, structural steel and other metal from the ravages of rust. Rust-Oleum outlasts ordinary protective materials two to ten times, depending on conditions.

Maintenance men hail Rust-Oleum's cost-cutting advantages. It can be applied to new or rusted metal after quick, easy preparation.

GET THE FACTS—MAIL THIS COUPON TODAY!

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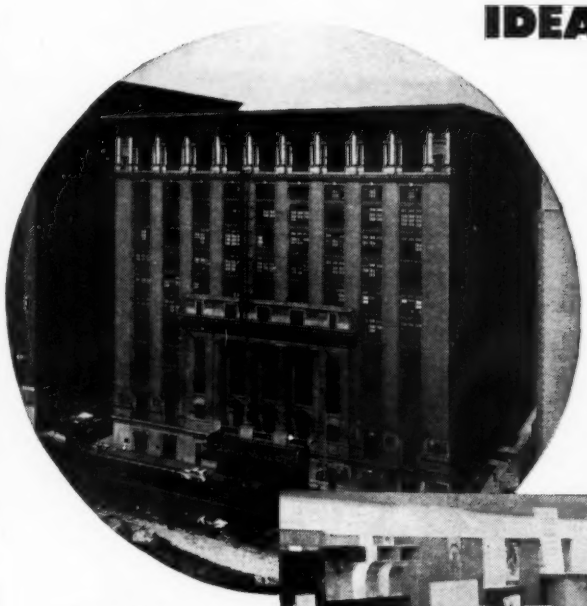
A Palace-ful of Profitable IDEAS

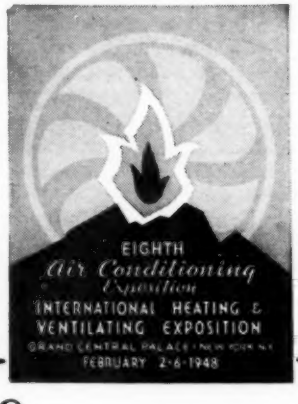


...on AIR CONDITIONING HEATING AND VENTILATING

Every available square foot of display space on 4 floors in spacious Grand Central Palace, New York City, will be teeming—from February 2 to 6—with arresting, idea-stimulating exhibits of the latest equipment being offered for supplying conditioned air, heat and ventilation to all types of public, commercial and industrial buildings. Every one of the more than 350 exhibitors will afford you a multiplicity of opportunities to supplement your fund of working knowledge . . . by studying and comparing newest developments . . . learning latest trends and practices . . . talking over your interests with engineering specialists on hand to give you practical ideas and suggestions on current problems and future plans.

In no other place can anyone interested in selling or applying air conditioning, heating or ventilating for industrial and commercial applications—get so much valuable information, vital new ideas for an expenditure of so little time.

Be sure to attend—remember the dates.



Under Auspices of American Society of Heating & Ventilating Engineers

8th Air Conditioning Exposition
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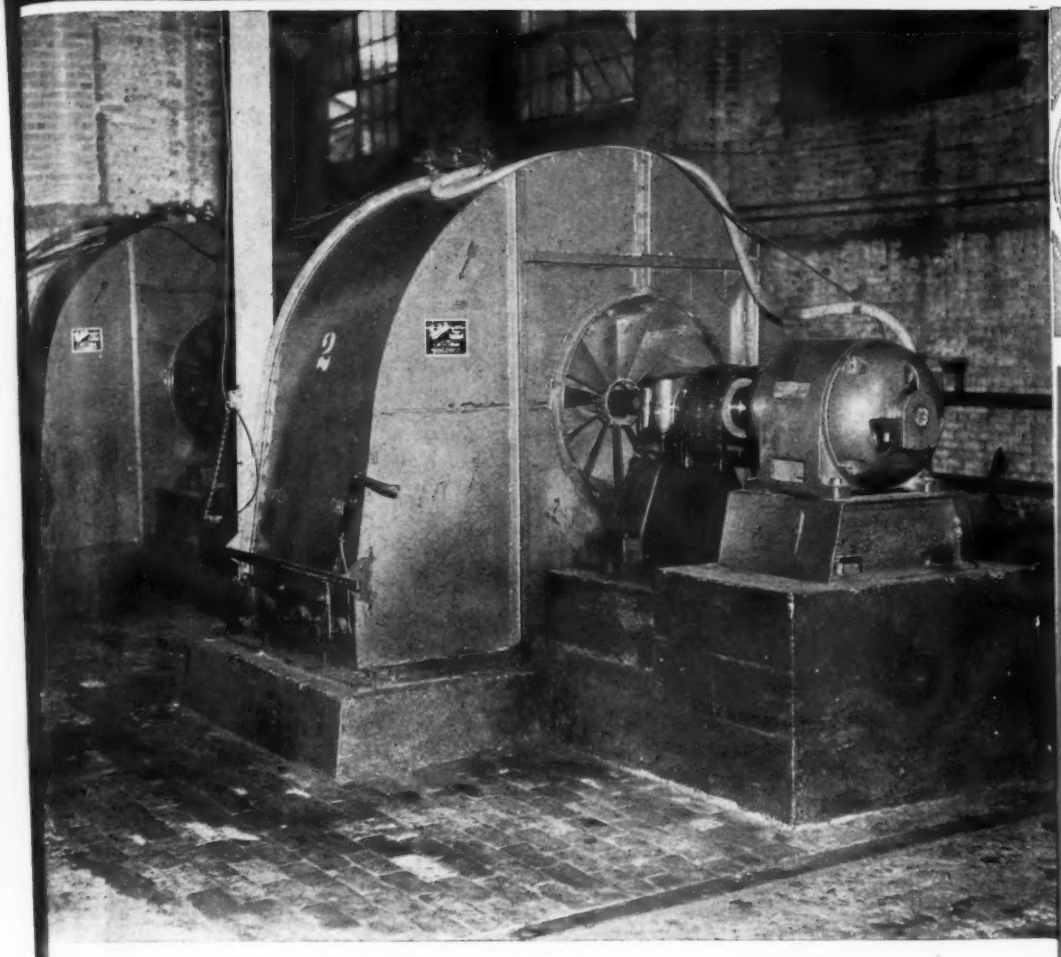

FANS by "Buffalo"

EQUIPMENT FOR

- ★ VENTILATING
- ★ HEATING
- ★ COMFORT COOLING
- ★ PROCESS COOLING
- ★ AIR TEMPERING
- ★ AIR WASHING
- ★ EXHAUSTING
- ★ BLOWING
- ★ FORCED DRAFT
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Everything A DRAFT FAN Needs

√ DURABILITY
√ ACCESSIBILITY
√ EFFICIENCY

● "Buffalo" Forced and Induced Draft Fans are engineered from ACTUAL POWER PLANT NEEDS. They are built to "go the distance" in the punishing job of boiler firing. All parts are easy to get at for replacement. Rotor and housing design gives you more air for your money.

ROTORS are heavy steel plate, hot-riveted for extra strength. Blades are curved for stiffness. Induced draft rotors have wearing strips and beads. All rotors are dynamically balanced.

HOUSING is heavy plate, hot-riveted or welded where possible, but of sectionally, bolted design to allow dismantling.

SHAFTS are extra large, of high quality, machined steel.

BEARINGS are self-aligning, large, easily serviced. For induced draft, water-cooled bearings are furnished.

WRITE for engineering data on these fans which last longer, allow ready parts-replacement and deliver more air.

BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

UTTING AIR COSTS IN EVERY BRANCH OF INDUSTRY

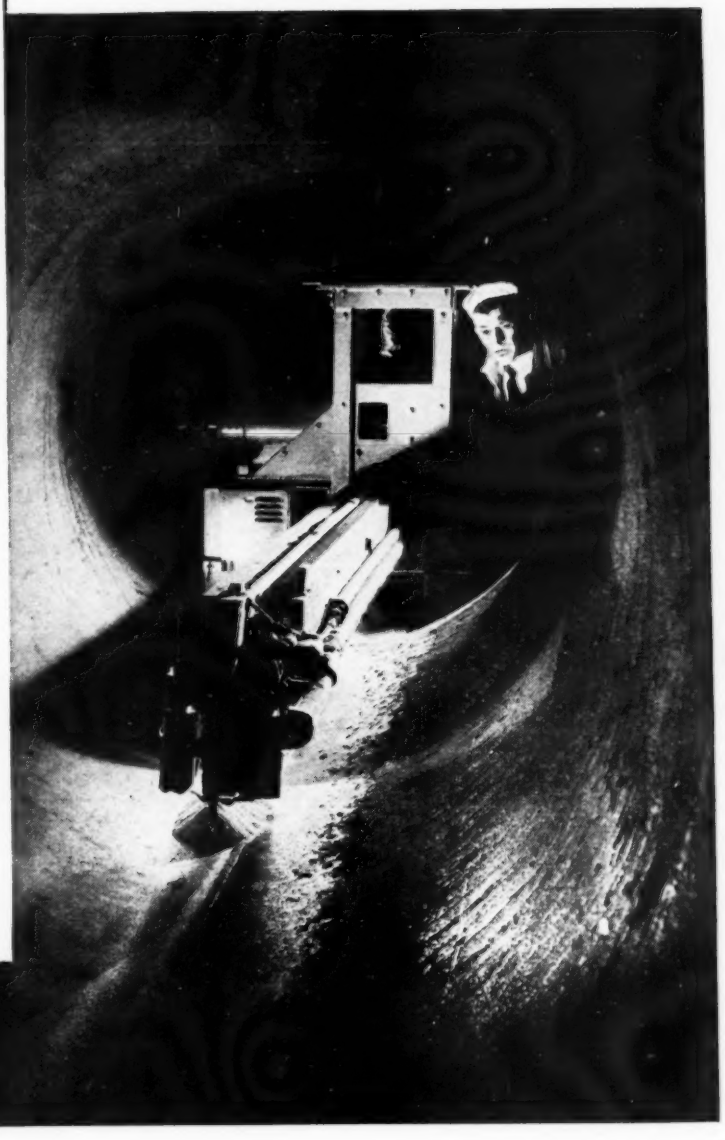
How will you have your welding?

There is no one piece of all-purpose equipment or any one method that will produce peak-quality welding on every type of job.

A continuous submerged arc track-welder, such as the one illustrated here, does a perfect job on longitudinal inside pipe seams. Conversely, the sections of large diameter vessels should be welded together on a rotating unit, where the seam on the outer circumference moves at a consistent speed past a fixed electrode.

Kellogg shops are equipped with these and every other standard welding device, plus some of our own invention. But more important to a "top" job are the unusually high qualifications of Kellogg welding operators and the perfection that results from a rigid check-up and inspection system.

It's common at the Kellogg plant to make as many as 1,000 X-rays of welds a day—which means that every welder performs with the expectation that his work may go before the all-seeing eye of the X-ray machine. It's extra care like this that puts that extra margin of quality in Kellogg work—a big reason why so many of the world's top industries head for Kellogg when there's a particularly tough job to be done.



FABRICATED PRODUCTS DIVISION

THE M. W. KELLOGG COMPANY

A SUBSIDIARY OF PULLMAN INC.

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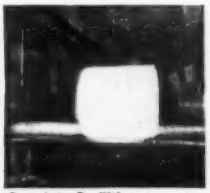
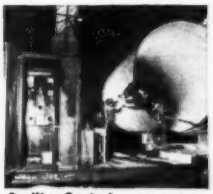
VESSELS • EXCHANGERS • CONDENSERS • HIGH PRESSURE AND HIGH TEMPERATURE POWER PIPING PROCESS PIPING • FORGED AND WELDED FITTINGS...IN ALL STEELS, ALLOYS OR SPECIAL COMBINATIONS

Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.

Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.



Complete Facilities for the fabrication of steel products from simple forgings to the most intricate 120 foot towers.



Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

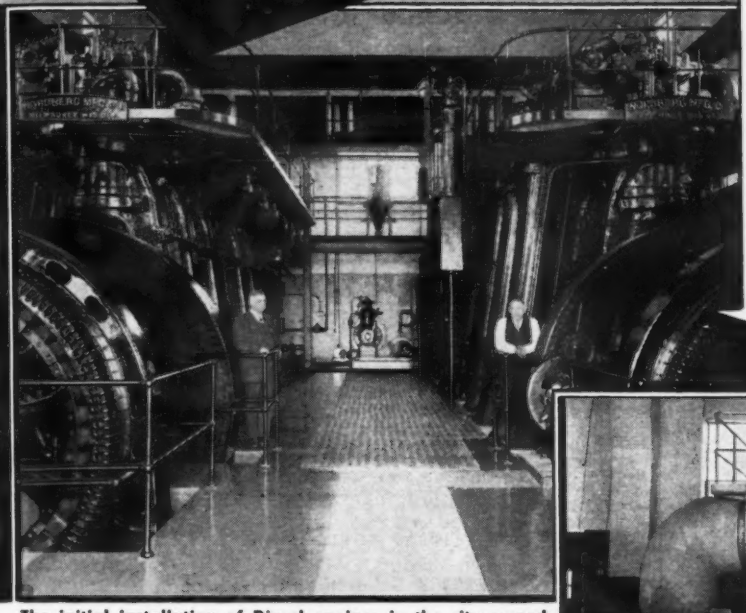
On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.

Top Welding Performance assured by specially designed equipment and exclusive employment of master operators.

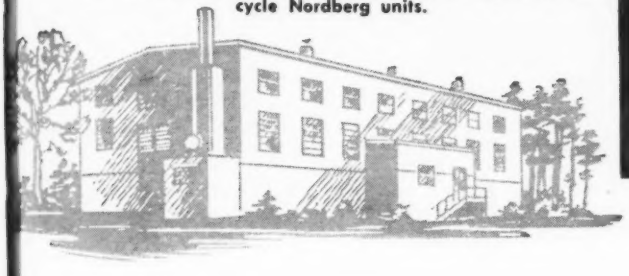
from STANDBY SERVICE . .

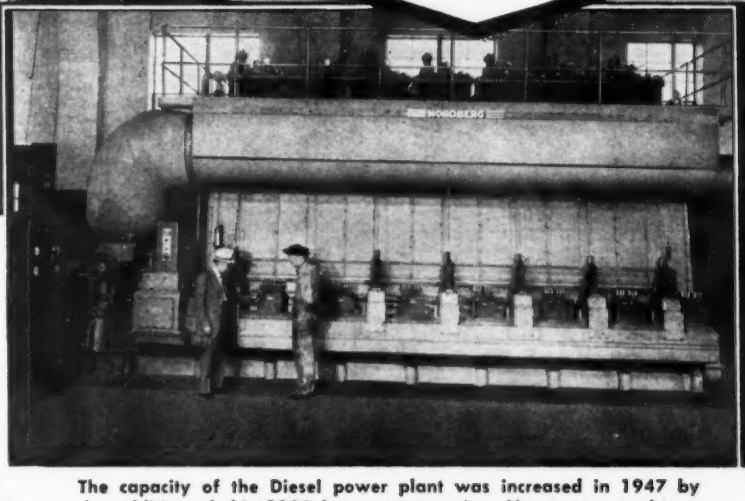
to MAIN SOURCE *of* POWER SUPPLY

1925



The initial installation of Diesel engines in the city-owned power plant at Marquette, Michigan was made in 1925 and consisted of two 1250 horsepower, air injection, two-cycle Nordberg units.





1947

The capacity of the Diesel power plant was increased in 1947 by the addition of this 3000 horsepower engine. Marquette now has a total of 4250 horsepower of Nordberg Diesel power.

IN 1888, the City of Marquette, Michigan built its first municipally owned electric utility. With ample water power available, it was only natural that hydro power was selected for the first plant. Later, two more water power plants were added, the three now having a combined capacity of 4700 KW.

When a serious power shortage arose in 1925 because of a failure of water supply, two Nordberg Diesels were installed in order to restore service quickly. While these 1250 H.P. units were originally planned for standby only, the increasing load required that the engines be kept in regular service. In 1946, these two, twenty-two year old engines operated about 16 hours a day and generated 5,613,500 KW hours during that year.

Here is another among the many users of Nordberg Diesels that have continued to place repeat orders on the basis of satisfactory performance.

NORDBERG MFG. CO., MILWAUKEE 7, WIS.

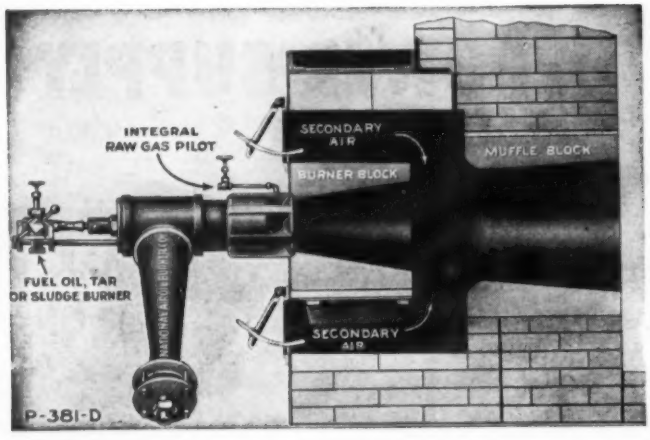
BUSCH-SULZER
A DIVISION OF NORDBERG

NORDBERG
DIESEL ENGINES

NORDBERG MACHINERY

NATIONAL AIROIL FUEL OIL - GAS BURNERS

TANDEM COMBUSTION UNIT



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A HIGH TURNDOWN RATIO WITH A STEADY FLAME...

It maintains a high flame temperature with either fuel oil or gas; can be brought quickly to full capacity with a clean flame; and flame can be regulated and directed to uniformly radiate heat to the absorbing surfaces without flame impingement. The Tandem Combustion Unit is also designed for firing vertically upward and for forced draft preheated air, when necessary. It may be applied to all types of boilers and process furnaces. For details about the Tandem Combustion Unit and the various types available, write

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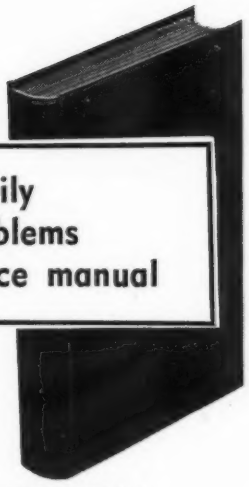

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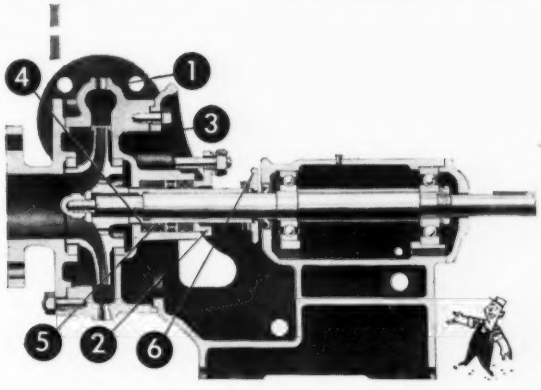

FIG. 3750

√ CHECK THESE IMPORTANT "SUPPORT-HEAD" FEATURES:

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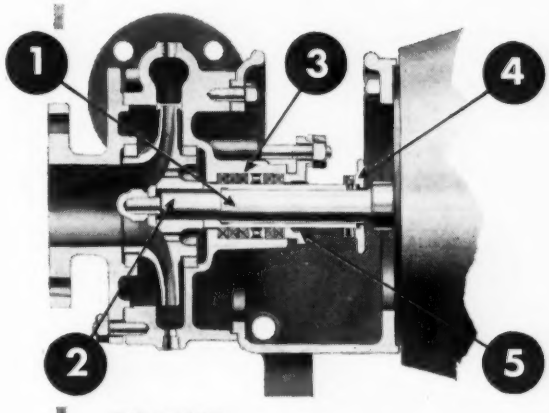

FIG. 3650

√ THESE FEATURES SAVE TIME, PROLONG PUMP LIFE:

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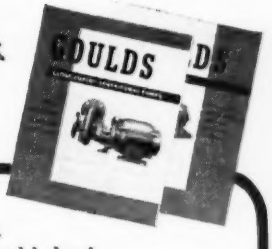

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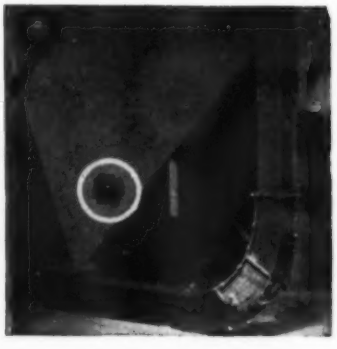

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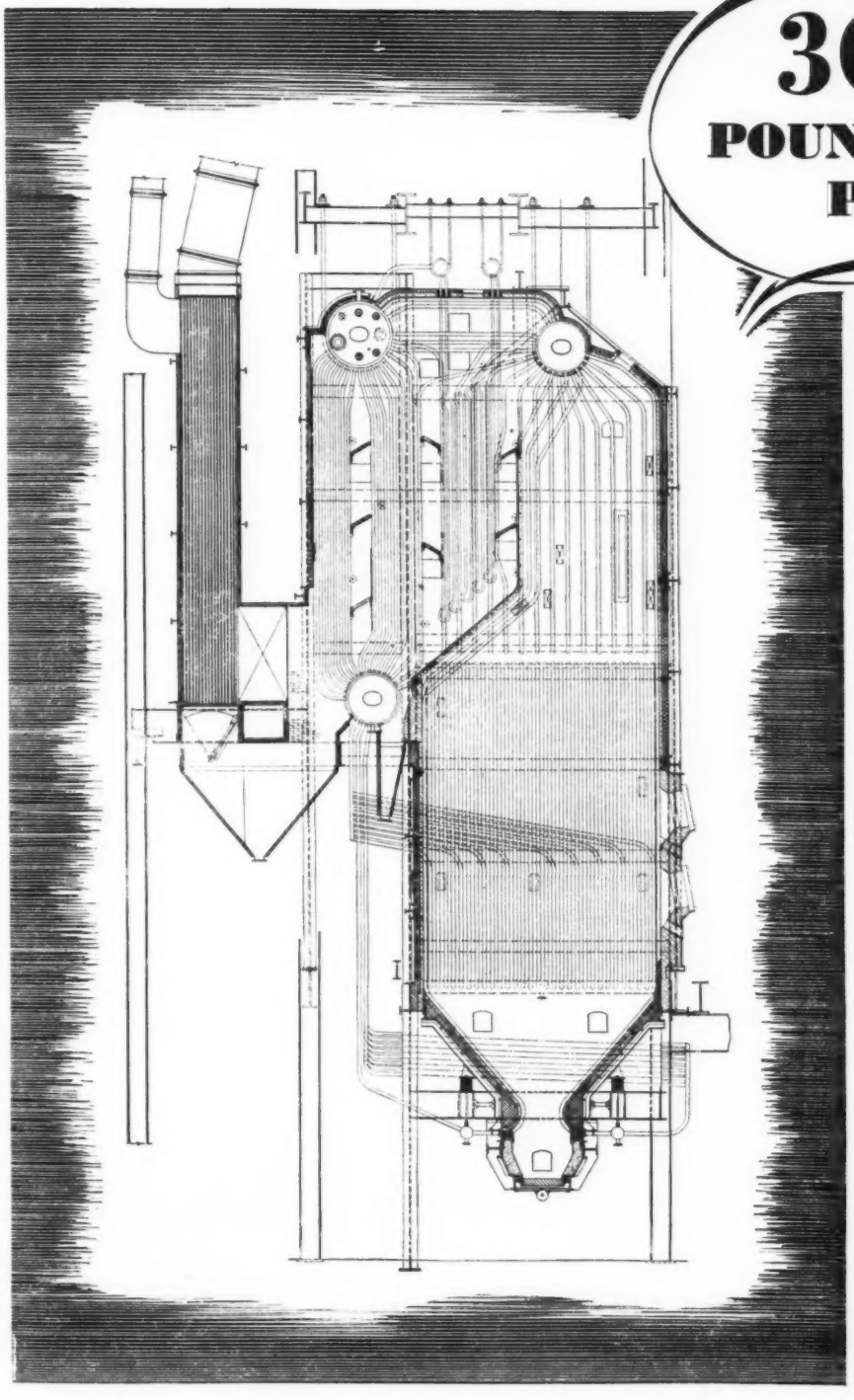

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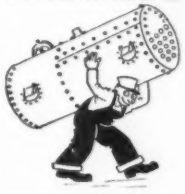

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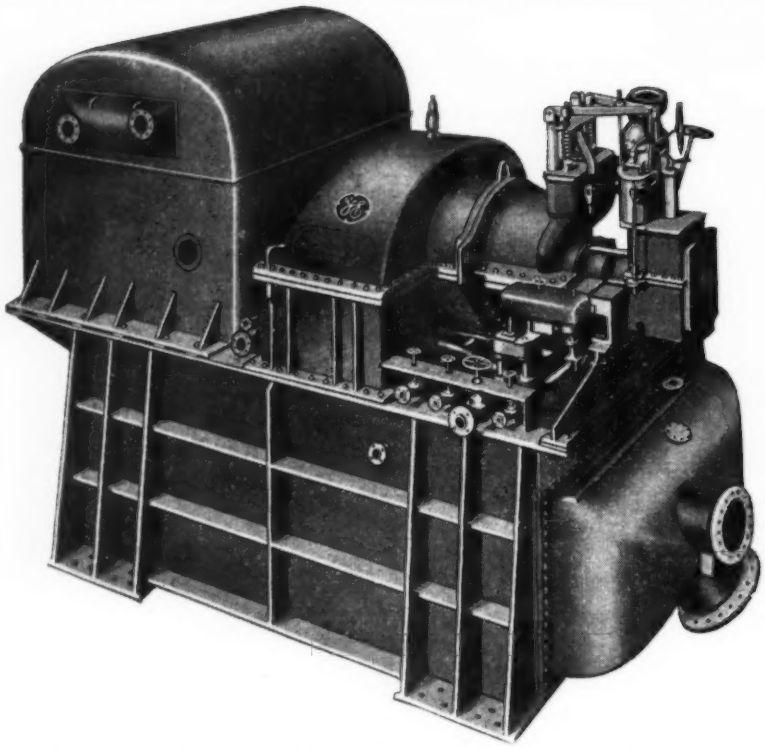
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
MARIEMONT Since 1912 CINCINNATI 27, OHIO

POWER PLANT MACHINERY



PACKAGE TYPE TURBINE GENERATOR UNITS AND BOILERS

4—1800 KW 80% P. F. 2250 KVA General Electric alternating current generators, type ATB, 3 phase, 60 cycle, 480/600/2300/4150 volts, 3600 RPM, direct connected to General Electric condensing turbines, 10 stage, 250/400# steam pressure, 0-275 deg. superheat, 725 deg. total temperature, 3600 RPM. Equipped with air coolers, surface condensers and auxiliaries.

4—60,000# steam per hour Foster Wheeler boilers, 435# pressure, 750 deg. TT, equipped with water walls, superheaters, economizers, soot blowers, and Todd oil burners.

New 1943 - Excellent condition

CONDENSING TURBO UNITS

3 phase 60 cycle

3750 KVA. Wstgh. 4160 volts, 200# steam
3125 KVA Wstgh. 600 volts, 250# steam
2250 KVA G. E. (4) 480 volts, 250/400# steam
1875 KVA G. E. 480 volts, 225# steam
1563 KVA Allis 2400 volts, 200# steam
1250 KVA G. E. (2) 2400/600 volts, 250# steam
750 KVA G. E. 2400 volts, 200# steam
625 KVA G. E. (2) 2300 volts, 200# steam
375 KVA G. E. (4) 480 volts, 400# steam

NONCONDENSING TURBO UNITS

3 phase 60 cycle

2500 KVA G. E. 480 volts, 150# steam, 15# exhaust
1563 KVA Allis 2300 volts, 200# steam, 15# exhaust
1250 KVA Wstgh. 2400 volts, 300# steam, 10# exhaust
750 KVA G. E. 480 volts, 115# steam, 5# exhaust
625 KVA G. E. 2300 volts, 200# steam, 7# exhaust
375 KVA G. E. 240 volts, 150# steam, 10# exhaust
250 KVA G. E. (4) 480 volts, 400# steam, 10# exhaust

EXTRACTION TURBO UNITS

3 phase 60 cycle

3750 KVA Wstgh. 2400 volts, 150# steam, 10# extraction
1563 KVA Wstgh. 2400 volts, 175# steam, 15# extraction
1250 KVA Allis 480 volts, 300# steam, 35# extraction
875 KVA Moore 2300 volts, 300# steam, 100# extraction
625 KVA Wstgh, 480 volts, 250# steam, 25# extraction

UNIFLOW UNITS

3 phase 60 cycle

625 KVA Skinner, 2300 volts, 140# steam, 5# exhaust
375 KVA Skinner, 2300 volts, 125# steam, 5# exhaust
312 KVA Skinner, 480 volts, 165# steam, 5# exhaust
280 KVA (2) Skinner, 2300 volts, 150# steam, 5# exhaust
250 KVA Skinner, 480 volts, 165# steam, 5# exhaust

SYNCHRONOUS MOTORS

6—3500 HP G. E. synchronous motors, 3 phase, 60 cycle, 11000/6600/2300/440 volts, 257 RPM.

DIESEL UNITS

3 phase 60 cycle

1000 KVA Busch-Sulzer, 2400 volts.
500 KVA Busch-Sulzer, 480 volts.
250 KVA Fairbanks Morse, 2400 volts.

GENERATORS

3 phase 60 cycle

2500 KVA (4) G. E. 2300/480 volts, 257 RPM.
1150 KVA Wstgh. 600 volts, 400 RPM.
750 KVA (2) G. E. 600 volts, 300 RPM.

MOTOR GENERATOR SETS

3 phase 60 cycle

300 KW G. E. 250 v. D. C., 440 v. A. C.
200 KW G. E. 250 v. D. C., 440 v. A. C.
200 KW C. W. 125 v. D. C., 2300 v. A. C.

ROTARY CONVERTERS

3 phase 60 cycle

3500 KW G. E. 225/285 v. D. C., 13800 v. A. C.
1500 KW (2) Wstgh. 270 v. D. C., 13800 v. A. C.

TRANSFORMERS

3 phase 60 cycle

2500 KVA Wstgh. 2400-480 volts
500 KVA (3) Allis Chalmers 2300/4160-460 volts

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BUILDING • • • *Telephone MAin 9514* • • • CLEVELAND 14, OHIO

A STANDARD OF QUALITY THAT IS NEVER LOWERED

Electrical Equipment

rebuilt and tested by our Electrical Engineers TO N. I. S. A. STANDARDS

MOTOR GENERATOR SETS

1—125 KW Crocker Wheeler 125 V. 1200 RPM. 2300 V., Squirrel Cage.
1—100 KW Elec. Mach. 125 V., 1200 RPM. 4150 volt, synchronous.
1—100 KW General Electric, 230 v., 900 RPM. TS 4150 v. syn.
1—50 KW Ridgeway 1200 RPM. 550 Volt, Motor Sq. Cage, 220 volt.
1—5 KW General Electric, AC Gen. 1800 RPM. 120 volt, single phase, DC Motor, 230 volt.
4—100 KW General Electric, 60 volt, 1200 RPM. 125 HP Squirrel cage 220/440 volt.

ENGINE GENERATOR SETS

1—150 KVA General Electric, Ames Uniflow 220 volt, 3 phase, non-condensing.
1—62½ KVA Westinghouse 240 volt, 3 phase, Fairbanks non-condensing.
3—13 x 15 Uniflow Engines 150/300 RPM. for Ice Compressors.
1—200/273 volt Gasoline Van Bierck 8 cyl. 1500 RPM.

TURBO GENERATOR SETS

1—300 KW General Electric ATB 240 Volt, 3 phase, condensing.
1—50 KW Allis Chalmers 3600 RPM, 125 volt, Terry Non-condensing.

PLATING SETS

1½ KW G.E., 1800 RPM 5/6 volts, squirrel cage motor.
12 KW Hanson Van Winkle 24 volt with exciter, 1200 R.P.M. with squirrel cage motor.

TRANSFORMERS

3—200 KVA General Electric, Type H, 2400 volt primary, 120-240 secondary.
1—200 KVA Pittsburgh 4000 volt, single phase 110/220 volt secondary.
1—1000 KVA General Electric Auto transformer, 3 phase, 4150 volt, 3 phase, 2406 volts.
1—100 KVA Westinghouse, 13200 volt, 250 volt, single phase.
3—75 KVA 440 to 220 primary, 120 to 240 secondary.
46—50 KVA Westinghouse, 13,800 primary, 120 volt secondary.
35—50 KVA G.E. 13,800 primary, 120 volt secondary.
5—50 KVA Westinghouse, 13,800 primary, 125 volt secondary.
5—50 Westinghouse 12,800 primary, 240/120 secondary.
10—27½ KVA General Electric brand new Air Cooled 440/220 220/110 single phase.
3—10 KVA Westinghouse Air Cooled, 450 volt, primary, 117 Volt secondary, single phase.

A. C. GENERATORS

500 KW General Electric .8 PF, 3600 RPM. ATB, 600 volts, DC exciter
240 KW General Electric .8 PF, 600 RPM. ATB, 600 volts, DC exciter.
200 KVA Allis Chalmers, 3600 RPM. 240 volt, 2 phase, DC exciter.
200 KVA Westinghouse, 600 RPM. 240 volt, 3 phase, DC exciter.
200 KVA Allis Chalmers, 900 RPM. 240 volt, 3 phase, DC exciter.
180 KW Westinghouse, 514 RPM. .8 PF. 550 volt, 3 phase.
2—167 KVA General Electric, 1200 RPM. .6 PF. 450 volt, 3 phase.
165 KW Electric Machinery, 514 RPM. 240 volt, 3 phase.
120 KW General Electric, ATB, .8 PF. 720 RPM. 2300 volt, 3 phase.
100 KW General Electric, ATB, 600 RPM. 240 volt, 3 phase, DC exciter.
62½ KW Allis Chalmers, 3600 RPM. 220 volt, 3 phase, DC exciter.
35 KW Columbia Elect. .8 PF. 1200 RPM. 240 volt, 2 phase, DC exciter.
31.3 KVA American Customs, .8 PF. 1200 RPM. 120/208 volt, 3 phase, DC exciter.
12.5 KVA Westinghouse, .8 PF., 1200 RPM. 240 volt, 3 phase, DC exciter.

SYNCHRONOUS MOTORS

150 HP General Electric, T.S. 900 RPM. 4160 volt, 3 phase, DC exciter.
75 HP. 1200 RPM. General Electric, 440 volt, 3 ph., DC exciter.
70 HP Electric Machinery, 180 RPM. 2200 volt, 2 phase.
40 HP Westinghouse, 1800 RPM. 220 volt, 3 phase, DC exciter.
35 HP General Electric, 1200 RPM. 2200 volt, 3 phase, DC exciter.
20 HP Westinghouse, 1800 RPM. .8 PF. 220 volt, 3 phase.

MOTORS—3 ph. 60 cycle
SQUIRREL CAGE

1—750 HP General Electric, 750 RPM, 6600 volt, 3 phase, 25 cycle.
1—150 HP General Electric 1K, 450 RPM, 440 volt.
1—125 HP U. S., 1200 RPM, vertical hollow shaft, 220 volt, 3 phase, 60 cycle.
1—450 HP Ridgeway 900 RPM, 2200 volt, 3 phase.
1—75 HP Westinghouse, 1800 RPM, 2200 volt.
1—75 HP General Electric, Type KT, 1200 RPM, 440 volt.
1—60 HP Westinghouse, 900 RPM, Type CS, 220 volt.
3—40 HP General Electric, Type KT, 900 RPM, 220 volt, 3 phase.
1—35 HP General Electric, Type 1, 600 RPM, 350 volt, 3 phase.
2—10 HP Westinghouse gear 440 RPM, output 440 volt, 3 phase.

MOTORS—3 ph. 60 cycle
SLIP RING

1—450 HP General Electric, 425 RPM, 1TC, 440 volt, 25 cycle.
1—100 HP General Electric, 720 RPM, 1M, 440 volt, 25 cycle.
1—60 HP, General Electric, 600 RPM, MT, 220 volt.
1—50 HP, General Electric, Type MT, 600 RPM, 220 volt.
1—50 HP F & B, 1800 RPM, BV, 220 volt.
1—50 HP General Electric, 900 RPM, IM, 440 volt.
1—40 HP Cont. 1150 RPM, SA55, 220 volt.
1—40 HP General Electric, 1130 RPM, MT, 220 volt.
1—40 HP General Electric, 900 RPM, MT, 220 volt.
1—40 HP General Electric, 900 RPM, MT1, 2000 volt.

JLHC

THIS SEAL IS YOUR GUARANTEE

"FOR POWER"

J. L. HEMPHILL & CO.

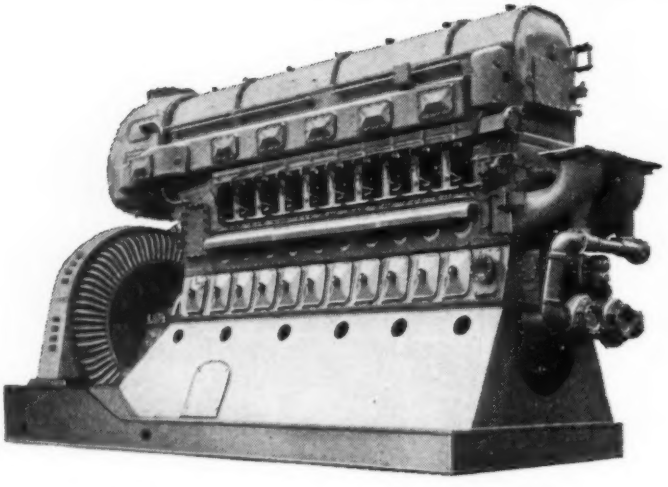
1604 53rd STREET, NORTH BERGEN, N. J.

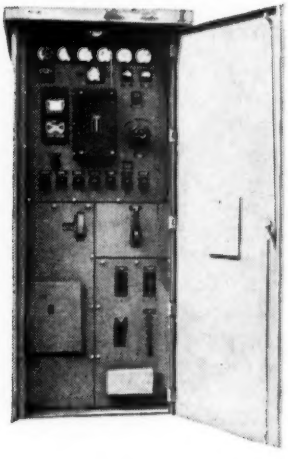
PHONE NEW YORK—LONGACRE 5-3227

PHONE NEW JERSEY—UNION 3-2600

ENGINEERED AGSCO DIESEL POWER

COMPLETE PLANTS IMMEDIATE DELIVERY





1250 KVA FAIRBANKS-MORSE GENERATOR SET, MODEL 38D8⅛ WITH *NEW* ELECTRIC MACHINERY ALTERNATORS, 3 PHASE, 60 CYCLE, 2300 VOLTS.

This unit is complete with switchboards, heat exchangers, pumps, cooling tower, silencers, and all other necessary accessories.

Some of Our Other Offerings

50 AND 60 CYCLE HEAVY DUTY DIESEL GENERATORS

KVA	Make	HP	Model	RPM
1250	Fairbanks Morse	1600	38D8⅛	720
1250	Cooper Bessemer	1500	LS-8	327
1250	General Motors	1600	16-278A	720
1250	Nelseco	1500	6MI-53	300
1000	Fairbanks Morse	1200	38D8⅛	600
900	General Motors	1200	12-567	720
625	Superior	750	OS	327
400	Ingersoll Rand	460	S	600
375	De La Vergne	448	VO	400
300	Fairbanks Morse	360	Y	257
156	Fairbanks Morse	150	32E14	300
100	Buckeye	150	E	325 (BC)

DIRECT CURRENT DIESEL GENERATORS IN STANDARD AND SPECIAL VOLTAGES

KW	Make	HP	Model	RPM
1000	Fairbanks Morse	1600	38D8⅛	720
1000	General Motors	1600	16-278A	720
660	Cooper Bessemer	950	LS	327
300	Baldwin	450	VO	400
100	General Motors	150	3-268A	1200
100	Superior	150	GDB-8	1200

WRITE FOR BULLETINS

DIESEL ENGINES

AG SCHOONMAKER CO., INC.

50 Church Street, New York 7, N. Y.

Cable Address: AGSCOMACH Phone: Digby 9-4350

BUSINESS EST. 1898

DIESEL GENERATORS

RE-NU-BILT BELYEA MOTORS

THE TRADE MARK that means "SUCCESSFUL OPERATION GUARANTEED"

Behind this name

RE·NU·BILT

ELECTRICAL EQUIPMENT REBUILT BY SPECIALISTS

BELYEA

THE NAME that says: "OUR REPUTATION IS YOUR PROTECTION"

SPECIAL General Electric Spirakore transformers 167 KVA, 2400/4160Y volt primary, 120/240 volt secondary, single phase 60 cycle, OISC. Can also furnish 240/480 volt secondary. Newly wound.

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	1000	Whse.	514	600	4150
1	1000	G.E.	900	600	2300/4150
2	1000	Whse.	900	600	6600/12500
1	1000	Al. Ch.	720	450	2300
2	750	Whse.	900	275	6600
1	750	G.E.	900	275	2300/4150
2	500	G.E.	720	600	2300/4150
1	500	G.E.	720	600	6600/13200
1	500	G.E. (3 u)	1200	250	440
1	500	G.E.	720	600	4400
1	400	G.E. (3 u)	720	125/250	2300
2	400	Whse.	1200	250	440/2300
1	300	G.E.	900	250	440
1	300	G.E.	720	550	2300/4000
1	250	G.E.	720	275	2300/4000
2	250	G.E.	1200	250	440
1	200	G.E.	720	125	440
1	100	G.E.	1165	250	440
1	100	G.E.	1170	125	220
4	90	G.E.	1180	60	220/440
2	75	Cr. Wh.	1160	250	220/440
1	75	G.E.	1180	125	2300/4000
1	60	Cr. Wh.	1750	250	220/440
1	50	G.E.	1145	125	220
1	48	G.E. (3 u)	1750	60	440
1	35	Whse.	1200	230	240

FREQUENCY CHANGER SETS

1—1000 KW—GE—2 Unit—3 Brg. Consisting of—1400 HP—4400 V, 3 ph. 25 Cy. Motor and 1000 KW—2300 V.—8 ph. 58.3 cycle gen. with exciter (Gen. can be reconnected for 800 KW 3 ph.)

1—840 KW—GE2 unit with 2 exciters consisting of 1700 HP—2300 V, 3 ph. 25 cycle motor and 1200 KVA.—.7 pf. 2400 V. 3 ph. 60 cycle gen.

ROTARY CONVERTERS

60 Cycle

KW	Make	Speed	D.C. Volts	A.C. Volts
1—1500	Whse.	720	600	2300
1—1000	G.E.	900	600	11000
1—1000	Whse.	900	600	11000
1— 750	Whse.	900	600	13200
1— 750	Whse.	720	250	6600
1— 500	G.E.	900	250	2300

TURBO-GENERATOR SETS

1—3000 KW Whse. 3750 Kva. 2300 V. 3 ph. 60 cy. with Parsons 200 lb. Cond. turbine.

1—3000 KW G.E. 3759 Kva. 2300 V. 3 ph. 60 cy. with G.E. 200 lb. Cond. turbine.

1—2500 KW G.E. 3125 Kva. 600 V. 3 ph. 60 cy. with 200 lb.; 15 lb. auto extraction turbine.

SPECIAL

1—2500 KVA G.E. Auto Extraction, 225 lbs., 500" F.T.T.—20 lbs. extraction. Surface condenser, 600 volts, 3 phase, 60 cycle. Panel and all auxiliaries.

1—2000 KW G.E. 6600 V. 3 ph. 60 cy. with G.E. 175 lb. Cond. turbine and d.c. exciter.

1—1500 KW G.E. 1875 Kva. 480 V. 3 ph. 60 cy. with G.E. 200 lb. Cond. turbine.

2—1250 KW G.E. 1560 Kva. 2300 V. 3 ph. 60 cy. with G.E. 175/200 lb. Condensing turbine.

1—1250 KW Al. Ch. 1560 Kva. 2300 V. 3 ph. 60 cy. with 200 lb. Condensing turbine.

1—1000 KW G.E. 1250 Kva.—2300/4100 V. 3 ph. 60 cy. with G.E. 135/175 lb. Cond. turbine.

1—500 KW G.E. 625 Kva.—240/480 V. 3 ph. 60 cy. with G.E. 200 lb. Cond. turbine.

1—300 KW G.E. 375 Kva. 480 V. 3 ph. 60 cy. with G.E. 200 lb., 10 lb. back pressure turbine.

1—300 KW Al. Ch. 120/240 V. d.c. geared to Whse. 440 lb. Cond. turbine.

1—200 KW G.E. 600 V. 3 ph. 60 cy. with 150 lb. non-cond. turbine and exciter.

1—125 Kva. G.E. 2300 V. 3 ph. 60 cy. with 125/200 lb. Non-Cond. turbine.

1—60 KW Whse., Condensing, 200 lbs. with 60 KW. 120 V. D.C. Gen.

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Type	Volts	Speed
1	4000	Whse.		4150	600
1	4000	G.E.	TSC	2400/4800	900
1	600	G.E.	ATI	600	900
1	500	G.E.	ATI	480	900

SPECIAL

500 HP—GE—KF-559—3575 RPM—2300 Volt Sq. Cy. Motor connected to Byron Jackson 325 GPM—10 stage, 3500 ft. head pump.

A. C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—35000	G.E.	TS	2300	257
1—2100	G.E.	ATI	4600	514
2— 900	Al. Ch.	(New)	2200	150
1— 600	G.E.	ATI	600	900
1— 400	G.E.	TS	440	600
2— 350	G.E.	TS	2200	150
1— 100	Whse.		550	600

SLIP RING

1—1000	Whse.	CW	2300	700
1— 900	G.E.	IM	2300	80
1— 750	Whse.	CW	2200	327
1— 450	Cr. Wh.	SR-31	2300	392
1— 450	G.E.	I	440	506
1— 350	G.E.	MT-442Y	2200/4000	253
1— 300	Whse.	CW	440	1750
1— 250	Whse.	CW	2200	500
3— 200	G.E.	IM	440/550	435
1— 250	G.E	MT-424Y	4000	257
1— 100	Al. Ch.	ANY	220	435

SQUIRREL CAGE

1—700	G.E.	KT	2300	705
1—250	G.E.	IK	440	600
1—200	G.E.	IK	550	865
1—150/70	G.E.	IK	440	1170/870
1—100	G.E.	IK (Vert.)	2300	450
1—100	G.E.	IK	2200	600

SPECIAL
MERCURY ARC RECTIFIERS

1—750 KW—GE—Type RHW—6 Anode 575 V, D.C. Form C with 2300 V, 60 cycle transformer and switching equipment.

1—500 KW—GE—Type RHW—6 Anode 575 V, D.C. Form B with 2300 V, 60 cycle transformer and switching equipment.

D. C. MOTORS

HP	Make	Type	Volts	Speed
2—800/1000	Whse.		450	600/720
1—800	G.E.	MPC	600	600
1—765	G.E.	MPC	500	1045/1350
1—700	G.E.	MCF	600	150/525
1—650	G.E.	MPC	250	115/145
1—375	G.E.	MPC	230	450/900
2—350	G.E.	MPC	250	450
1—335	Whse.	MQ	250	300/900
1—300	G.E.	DMC	230	400/600
1—300	G.E.	MPC	230	275/550
1—250	G.E.	MPC	230	400/500
1—230	Al. Ch.		230	700
1—150	G.E.	MPC	230	250/450
8—150	Cr. Wh.	83H-TEFC	230	890
1—150	Cr. Wh.	CMC-65H	230	1150
2—125	G.E.	CO-1832	230	625
1—125	G.E.	CD-125	230	1150
1—115	Rel.	T	230	1200
4—101	Whse.	SK	230	485/950

40th year OF BUILDING A REPUTATION FOR QUALITY

BELYEA CO., INC.

Main Office and Shop

43 HOWELL ST., JERSEY CITY 6, N. J.

Phone—Journal Square 2-3334

Also N. Y. City Line—Rector 2-7150

Reliably Rebuilt—YEAR Guarantee

A. C. Motors Generators

Squirrel Cage Motors

H.P.	Make	Type	Speed
300	West.	CS-875S	1700
150	Al. Ch.		720
147	West.	25 cy.	715
125	Cent.		1150
125	El. Prod.	B.B.	1150
125	G.E.	TEFC	1200
100(3)	G.E.	XP	900
100	G.E.	TEFC	900
100	G.E.		1200
100	Al. Ch.		680
75	G.E.	KF	3600
75	Al. Ch.		1800
75	G.E.	IK	1800
75	G.E.	KT-347	1200
50	Master	PA-405	1760
50	G.E.	KF-504	1150
50	Ideal	A	1150
50	G.E.	Class 2G	1200
50	West.	XP	900
40	G.E.	XP	1800
40	G.E.	XP	900
30	West.	CS-445	875
25	West. (2)	3S-364	3450
25	G.E.	XP	1200

Slipring Motors

600	Cr. Wh.		514
150	G.E. (2)	IM	600
100	Al. Ch.		695
100	Wagner	25 cy.	480
75	G.E. (2)	IM	600
60	G.E.	TEFC	720
50	Al. Ch.	ARY	600
50	G.E. (2)		514
40	G.E.	IM	1200
40	G.E.	MT-352	600
30	West. (2)	CI	900
30	G.E.	MT-042	720

Synchronous Motors

600	G.E.	900
150	Cr. Wh.	900
50	G.E.	1200

Generators

KW	Make	Speed
150	G.E.	600
100	West.	600

D.C. to A.C. Gen.

Size	Make	D.C.	A.C.
25	Star	115	120
25	Ideal	115	440
25	El. Mchy.	230	440
7½	Hertner	115	440
5	El. Spec.	110	110

D. C. Motors

230 V. Variable Speed

H.P.	Make	Type	Speed
150/200	West.	SK	400/1200
100	Rel.	1050T	400/1000
75	Cr. Wh.	CMC	375/750
60	G.E.	C	480/1100
50	West.	SK	500/1500
40	G.E.	CD	500/1500
35	G.E.	RF	500/1500
25	G.E. (3)	RF12	500/1500
25	West.	SK140	400/1200
20	G.E. (2)	RF12	400/1200
15	West.	SK93	600/1200
15	E.D.	10S	500/1500
15	West.	SK	250/1500
10	G.E.	RF10	600/1800
10	West.	SK	600/1200
10	G.E.	RF	400/1600
10	G.E.	RF	400/1200

230 V.

350	Al. Ch.		500
100	G.E.	CDP	1750
100	West.	SK163	1150
60	West.	SK160	680
50	West.	SK133	1300
50	Diehl	K10	850
50	West.	SK	750
40	G.E.	RC	1750
40	G.E.	RC	1075
40	G.E. (2)	DLC	1050
35	West.	SK	1150
30	G.E.	RC	1100
30	West.	SK	975
25	Rel.	92T	1150
25	West. (4)	SK113	860
25	E.D.	10S	800
20	West.	SK60	1750
20	West.	SK83	1750
20	G.E.	CD	1200
20	Star (2)	SHB30	1729

115 V.

25	Star	SQ15L	2400
25	G.E.	CDM85	1800
25	G.E.	CDM95	1200
20	G.E.	CD83	1750
20	West.	SK110L	750
10	L.A.	ONA284	3500

D. C. Generators

600 V.

KW	Make	Speed
200	Cr. Wh.	900
30	Burke	1750
30	E.D.	1150

250 .

KW	Make	Speed
330	Elliot	1200
300 (2)	G E.	1200
150	West.	900
150	West.	1180
150	G.E.	600
50	G.E.	1200
40	G.E.	1750
30	Cont.	1200
25	G.E.	1200
15	G.E.	1750
10	Star	1750
7½	West.	1200
5	West.	1750

125 V.

Kw	Make	Speed
250	G E.	720
100 (2)	West.	900
100	G.E.	1200
50	Sturt.	2800
40	Cent.	1450
20	Deleo	1200
15	G.E.	1150
10	Rogers	1450
7½	West.	1200
5	G.E.	1750

Low Voltage

Amps.	Make	Voltage
5000	Col.	6/12
2000	H.V.W.	6/12
1000	Col.	6/12
1000	H.V.W.	12/24
750	Star	15
1000	G.E.	15
600	Rel.	24
800	G.E.	33
1600	G.E.	30
800	G.E.	50
1200	G.E.	32
800	G.E.	30
100	G.E.	75
160	Cent.	75
1500	West.	90

Miscellaneous

Pyrometers

40—Leeds & Northrup Model C-S & R.

D.C. Starters

150—230 V. Cutler-Hammer, D.C. automatic, 5 H.P. to 75 H.P.
100—230 V. Cutler-Hammer, manual, 1 H.P. to 3 H.P.
250—5 H. P. 115 V. Cutler-Hammer, magnetic.
75—1½ H.P. 230 V. General Electric, compound.
40—7½ H.P. 230 V. Cutler-Hammer reversing magnetic.

A.C. Starters

1—250—H.P. 4150 V.
1—150/200 H.P. G.E. Red, Volt. 440 V. Synchronous Starter.
40—Magnetic multi-speed A.C. up to 25 H.P.
40—50 H.P. Cuter-Hammer 440 V.
300—25 H.P. Ward-Leonard, 440 V.
1100—7½ H.P. Cutler-Hammer, 440 V.

Air Compressors

10x6 Gardner, 30 lbs.
12½x12 American, 125 lbs.

Pumps

Let'ourtney—5 stage, 675 GPM, 1100 ft. head.

M. D. Blowers

50—1200 CFM—American, 3" static.
100—3000 CFM—U.S., 3" static.
75—200 CFM—Bayley, 2" static.
2—7½ H.P. Spencer.

230 V. D.C. Monorail Hoist

17—4000# Shepard
1—4000# Cleveland
1—3000# Shepard
1—3000# Cleveland
2—2000# Harnishfeger
2—2000# Shepard

400 Cycle Gen.

8—½ to 20 KVA.

Meters

20—Weston Portable—A.C. and D.C. Model 155.

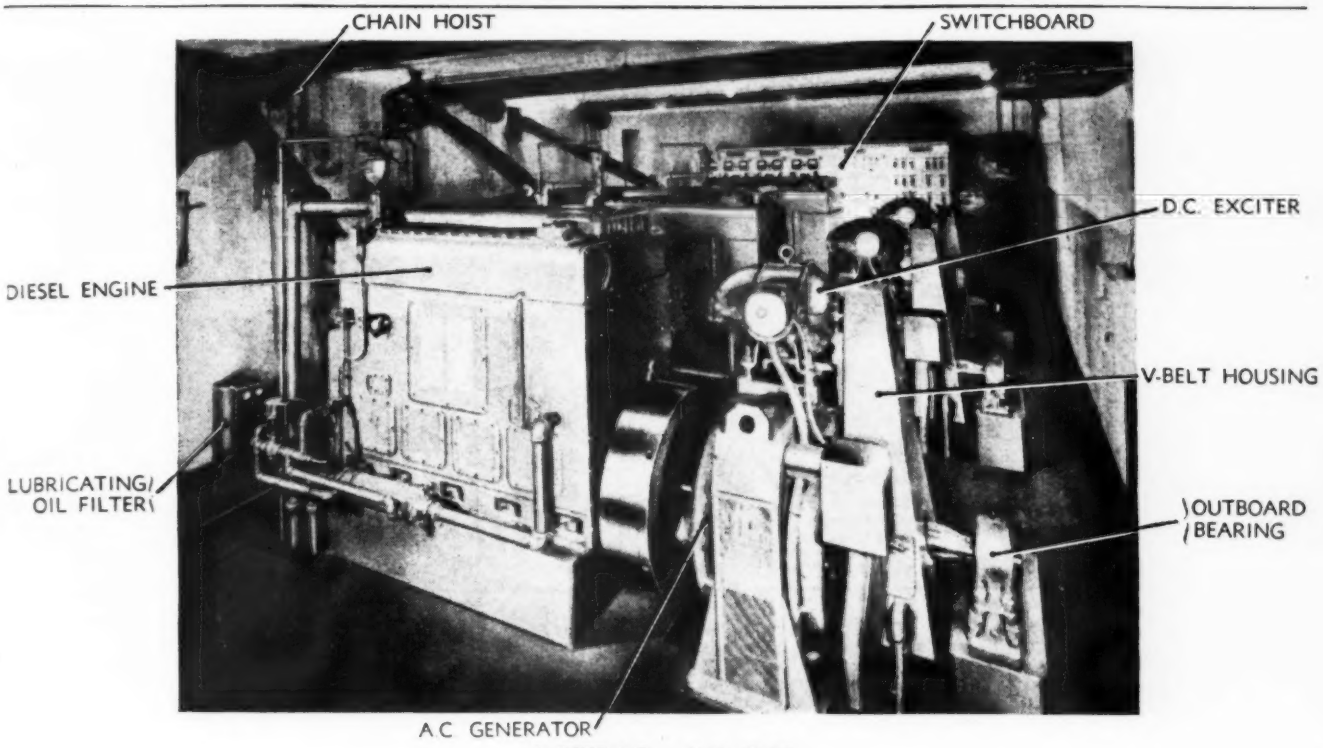
ONLY PARTIAL LIST — SEND FOR LIST No. 11

EST. 1910 **L. J. LAND INC.** 37TH YEAR

New England Representative:
BOSTON, MASS.
411 Atlantic Ave.
Phone: Liberty 4300

146 GRAND ST., NEW YORK 13, N. Y.
PHONE: CAnal 6-6976
South Western Representative
HOUSTON, TEXAS, 1400 Carr St., Phone: Charter 4-6558

Pennsylvania Office:
READING, PENNA.
10th & Exeter Sts.
Phone: Reading 2-6866



NEW 1945

561 KVA Diesel Electric Power Plant, Complete.
(Same as photograph above.)

Actual Use 75 to 100 hours test service only.
Was emergency stand-by plant—Really NEW!

SPECIFICATIONS

GENERATOR
Westinghouse, 187 KVA, 150 KW 80% Power Factor, 3 phase, 60 cycle, 460 volt, 235 Ampere, 600 RPM, drip proof protected alternator, with 5 KW, Westinghouse SK63 exciter.

SWITCHGEAR
This equipment is of the cubicle type dead front. Each generator has control panelboard mounting the following instruments: 0-300 Ampere A.C. ammeter, 0-80 Ampere D.C. ammeter, Unit-hour operation meter, Ammeter selector switch, synchroscope switch, voltage regulator transfer switch, engine Governor motor control switch, motor operated air circuit breaker with breaker control switch, with current "on" and "off" indicator lights, generator field discharge switch, generator and exciter rheostats, and control handles, and Westinghouse type SRA2 voltage regulator, also generator "on" indicator light.

AUXILIARY SYNCHRONIZING PANEL
with A.C. machine voltmeter, buss voltmeter, frequency meter, synchroscope and synchronizing lamps.

GROUND DETECTOR PANEL
with selector switch, buss voltmeter selector switch, and detector lamps.

DISTRIBUTION PANELS
providing the following circuits:
1—800 Ampere double throw knife switch
2—600 Ampere air circuit breakers
1—200 Ampere AQB breaker.
1—100 Ampere AQB breaker
18— 50 Ampere AQB breakers
9— 35 Ampere AQB breakers
7— 15 Ampere AQB breakers
including also:
3—15 KVA Westinghouse air-cooled type VR 480/450 volt primary, 120 volt secondary air-cooled transformers.

POWER HOUSE AUXILIARIES
2—1 ton Monorail chain blocks.
1—1 H.P. motor driven Buffalo ventilating exhaust fan.

ENGINE
240 H.P. 600 RPM, Buckeye, Model 80, 4 cycle, 4 cylinder, 10½" bore 12" stroke full diesel, cold starting, totally enclosed, pressure lubricated.

STARTING SYSTEM
7½ H.P. electric motor driven Gardner, 250 lbs. compressor. Auxiliary gasoline driven 250 lbs. Gardner-Denver compressor. 3—Air starting tanks.

COOLING SYSTEM
Each engine has Buffalo, type EWC, size 15, evaporative cooler with individual motor driven pumps and fan, damper and temperature control. 25 gallon surge tank with each engine.

FUEL SYSTEM
With the three engines, there are two 100 gallon fuel oil Day tanks with motor driven pump and complete electrical control. Each engine has complete Bendix fuel injection pumps and injectors and suitable filters.

LUBE OIL SYSTEM
Each engine is equipped with Hilco-Hyflo type FOA lube oil purifier which is equipped with necessary heating elements and automatic control. Engines are arranged for dry sump operation.

EXHAUST SYSTEM
Each engine is equipped with MUC-12 Maxim exhaust silencer, and including also flexible seamless steel exhaust line.

ENGINE INSTRUMENT AND CONTROL
Each engine has the following: Motor operated Woodward Governor, Selective pyrometer for exhaust gasses, lubricating oil pressure gauge, lubricating oil inlet and outlet thermometers, water outlet thermometer. Honeywell alarm signal system.

IMMEDIATE SHIPMENT!—Can Start Shipping Today!

WIRE or PHONE!

L. J. LAND, INC., 146 Grand St., New York 13, N. Y., Phone CAnal 6-6976

Motors

. . . always a wide selection . . . always unusual values

Listed below a few of the motors available in a hurry from Wente

SQUIRREL CAGE
3 Phase, 60 Cycle, 220 or 440 Volt
(Other voltage as noted)

Qu	HP	Make	Type	Speed
1	250	G.E.	KF Vert.	3600
3	200	G.E.	K-566, 2300 Volt	720
1	250	F.-M.	HF, 2200 Volt	720
1	150	Al. Ch.		1750
2	125	Ch.Wh.	126Q	430
1	120	G.E.	FT	3600
1	60	Reliance	AA	900
2	60	R.&M.	L	1200
1	50	Al. Ch.	AN	900
1	50	G.E.	I 2200 Volt	900
1	50	G.E.	I	720
1	50	West.	MS 25 Cycle	720
1	50	Wagner	BM	495
1	50	Al. Ch.		490
2	35	Al. Ch.	2 phase	900
1	35	Al. Ch.		900
1	35	G.E.	I 25 Cycle	730
1	30/30	West.	CS TEFCBB	1800/900
1	30	F.M.	QZK Open BB	1200
1	30	Cr. Wh.		900
2	30	Al. Ch.	AS 2 Phase	900
1	30	Century	AS	720
1	25	Howell		1200
1	25	F.M.	QZK B.B. New	1200
1	25	Wagner	BP	1200
1	25	Burke	EM3	900
1	25	Lincoln		900
1	25	Al. Ch.	AN	720
1	25	G.E.	M10	720
1	25	West.	MS 25 Cycle	600
2	20	U.S.	SC SP B.B.	1800
2	20	F.M.	QZK B.V. New	1800
1	20	West.	CS	1800
1	20	Howell	N. Vert. B.B. New	1200
1	20	F.M.	KRV	1200
1	20	Cr. Wh.		900
1	20	G.E.	I-K 2200 Volt	900
1	20	Cleve.	M	900
1	20	Al. Ch.		900
1	20	West.	MS 25 Cycle	900
1	18	West.	MS (Elev.)	720
1	15	F.M.	HLS	3600
4	15	F.M.	QZK B.B. New	1800
2	15	West.	MS 25 Cycle	715
1	10	Al. Ch.		1800
1	10	Imperial	EH B.B.	1200
1	10	West.	CS 25 Cycle	725
5	7½	G.E.	KT	1800
1	7½	West.	CS	1800
3	7½	Wagner	11VRW	1800
3	7½	G.E.	KT	1200
20	3	Imperial	E (New)	1200

Approx. 200 New motors from 2 HP—30 HP.

SLIP RING & SYNCHRONOUS
3 Phase, 60 Cycle, 220 or 440 Volt
(Other voltage as noted)

Qu	HP	Make	Type	Speed
1	445	El. M.	Syn.	900
1	300	G.E.	ATISYN	1800
1	300	El. M.	2300 Volt	360
1	100KW	G.E.	ATB Syn.	900
1	100	G.E.	I-16 2200 Volt	450
1	75	F. M.	BV 2200 Volt	1800
1	75	West.	(New) Syn.	1200
1	60	Ideal	AVX	1200
1	50	G.E.	I 25 Cycle	700
1	50	Al. Ch.		720
1	50	Ideal	AV 2200 Volt	600
1	40	G.E.	MT	1200
1	40	Al. Ch.		1200
1	40	G.E.	MT	900
2	40	West.	CW 2200 Volt	900
2	40	West.	CW	900
2	40	Al. Ch.		900
1	40	West.	CI	730
1	40	Burke	EMV7	1150/550
1	35	Al. Ch.		720
1	35	G.E.	I-12	600
1	30	Al. Ch.	2200 Volt	720
1	25	Cr. Wh.		1200
1	25	West.	CW	720
1	25	West.	MW	720
1	25	G.E.	MT Tot. Encl.	600
1	25	G.E.	MT	400

DC—230 Volt

Qu	HP	Make	Type	Speed
1	130	Cr. Wh.	CMC 550 Volt	1200
1	100	G.E.	CD	1200
1	100	West.	SK	1800
1	100	G.E.	RC38	600
1	100	G.E.	PCS 440 Volt	400
4	100	Cr. Wh.	CMC	225/550
1	75	Diehl	K11	700
1	60	West.	SK 115 Volt (Vert.)	1200
1	60	G.E.	FF1	1200
3	50	West.	SK	1200
1	40	Rel.	440 Volt B.B. Vert.	1800
1	40	Rel.	440 Volt B.B. (Vert.)	1200/1800
1	25/40	Cr. Wh.	CMC 440 Volt (Vert.)	1200/1800
1	40	Rel.	B. P.	400/1500
2	40	West.	SK	1200
1	40	G.E.	RC	1200
7	40	West.		775
1	35	G.E.	OMTEBB	1300
1	35	West.	SK	1200
1	35	Al. Ch.		1200
1	35	G.E.	DLC	700
2	30	El. Dy.	16S	625/1250
5	30	Rel.	92TF	1800
1	30	Rel.	131 440 Volt (Vert.)	1200
1	30	G.E.	RC	1200
1	30 KW	Al. Ch.	110 Volt	925
1	27½	G.E.	CVC116	1800
1	25	Cr. Wh.	CM 110 Volt	900/1200
1	25	Al. Ch.	E120	500/1500
1	25	Rel.	25P	250/1000
1	25	G.E.	RF	300/900
1	25	F.M.	IRC	400/800
6	25	West.	SK	1200
7	25	West.	SK	850
2	20	Rel.	131T	1000/2000
2	20	West.	SK	750/1500
1	20	Diehl	K9	500/1000
1	20	G.E.	CD	400/1600
1	20	G.E.	RF	250/1000
1	20	Lincoln	FKW B.B.	1800
6	20	Cr. Wh.	CMC Enclosed	1800
1	20	Cr. Wh.	CMCTEBB (Exp.)	1200
1	20	Rel.	92T	1200
2	20	West.	SK	1200

DC—230 Volt

Qu	HP	Make	Type	Speed
1	20	West.	SK	900
1	20	G.E.	RC	900
7	20	West.	SK	750
1	20	West.	SK	500
1	15	West.	SK63	1800
1	15	West.	SK113 Encl.	1800
1	15	F.M.	D B. B.	1150
6	15	Rel.	66T	1150
2	15	Cr. Wh.	CCM	1150
1	15	Cr. Wh.	CCM To.. Encl.	1500
1	15	West.	SK83	1150
2	15	West.	SK80L	1150
1	15	G.E.	CD	1150
1	15	West.	SK90	850
1	15	West.	KS Crane	630
8	15	Rel.	92F	850/1700
2	15	G.E.	CO Crane	650/2700
1	15	Rel.	131T 115v.	600/1500
2	15	West.	SK	600/1200
1	15	Rel.	78T	400/1600
1	15	G.E.	RF11	400/1200
1	12½	West.	SK	750/1500
1	12	G.E.	RF	575/1725
1	10	West.	SK7	850/1700
2	10	G.E.	RF10	600/1800
1	10	West.	SK90	600/1800
7	10	West.	SK80L	500/1500
20	10	Al. Ch.		500/1000
1	10	Rel.	92TF	400/1000
1	10	West.	SK	250/1000
6	10	Cr. Wh.	CM TEBB	1800
1	10	Century	R304	1800
15	10	West.	SK	1150
2	10	West.	SK 115 Volt	1150
3	10	Rel.	46TF	1150
1	10	G.E.	RC9	1150
2	10	Rel.	66TF	850
2	10	G.E.	RC	850
3	10	West.	SK70	850
1	10	G.E.	RC29 550 Volt	850
1	10	Colonial		950
14	7½	West.	SK33	1750
4	7½	West.	SK6C	850
20	5	West. & Gen. Elec.		1750
20	5	West. & Reliance		1150
35	5	West.	SK 43	850

Hundreds of other DC motors not listed.

27—New vertical, T.E.F.C.B.B., 3 Ph., 60 Cy. 220/440 volt as follows:
1—Fairbanks-Morse, 3 HP. ty. QZCU, Fr. 254, 1200 RPM Exp.
2—General Electric 3 HP. ty. K Fr. 254 1200 RPM
8—General Electric, 7½ HP. ty. Fr. 324, 1200 RPM
8—Delco, 7½ HP. type C. Fr. 324, 1200 RPM
1—Howell, 7½ HP. type KV. Fr. 284, 1800 RPM
5—General Electric, 15 HP. type K, Fr. 365, 1200 RPM
2—Howell, 15 HP. type KV. Fr. 365, 1200 RPM

1—New General Electric 250 HP. type KF, Frame 549-A, 440 volt, 3 phase, 60 cycle, 3600 RPM vert., direct connected to Bingham type 2, 22 stage, double case, 3600 RPM, 3820 head, 175 GPM

1—New Allis Chalmers 200 HP. type ARZ, 2300 Volt, 3 phase, 60 cycle, 3600 RPM, totally enclosed fan cooled, ball bearing.

1—150 KW Westinghouse synchronous M-G set, 275 volt DC, 4400 volt AC, 3 phase, 60 cycle, 900 RPM, AC control & DC panel
1—150 KW General Electric M-G set 250/275 volt DC, 440 volt AC, 3 phase, 60 cycle, 900 RPM
1—100 KW Ridgeway synchronous M-G set, 250 volt DC, 2300 volt AC, 3 phase, 60 cycle, 1200 RPM with AC control & DC panel
1—200 KW Burke synchronous M-G set, 250 volt DC, 440 volt AC, 3 phase, 60 cycle, 900 RPM with AC control & DC panel
1—30 KW Westinghouse M-G set, 125 volt DC, 2300 volt AC, 3 phase, 60 cycle, 900 RPM with AC control & DC panel

6—Practically new 40 KW Reliance & General Electric variable voltage M-G sets, 250 volt DC, 220/440 volt AC, 3 phase, 60 cycle, 1800 RPM, complete with exciters all control and drive motors. All motors ball bearing, enclosed M-G set, exciters and control mounted in fan cooled enclosure. Drive motor G.E. type CD, frame 1441, 40 HP, 230 volt 400/1600 RPM, enclosed, ball bearing, 50° Cont 250 RPM, 1 hr. 50°

The Wente Electric Co.

Hamilton — *Rebuilt Motors and Generators Since 1906* — **Ohio**

PHONE HAMILTON 707

GLOW ELECTRIC CO

SQUIRREL CAGE MOTORS

HP	RPM	Volts	Make
350	514	440	GE-I
250	600	2300	Triumph
223	3600	4150	GE-FR
125	340	220	A-C
100	514	220	A-C
100	450	220	A-C
75	720	2300	Wagner
75	360	220	GE-I
60	3600	2300	GE-KT
60	720	2300	Wtg.-CS
40	900	2300	Wtg.-CS
35	600	220	FT. Wayne
30	720	220	GE-HI
25	1200	2300	GE-I
25	900	220	GE-FTR
25	900	220	Wtg.-CS
25	720	220	Wagner
25	600	440	GE-I
20*	1800	220/440	F-Morse
20*	1200	2300	F-Morse
20	900	440	Wtg.-CCL
20	900	2300	Wtg.-CS
20*	1800	220/440	Master
15	3600	220	GE-KT
15	1800	220	Wtg.-CS

ENCLOSED SQUIRREL CAGE

HP	RPM	Volts	Make
125*	1200	440	GF-TEFC-BB
7½*	1800	dual	Wagner-TEFC-BB
7½*	1800	dual	Master-TEFC-BB
7½	1200	dual	GE-HI Slip-TEFC-BB
7½	1090	220/440	GE-KR, high slip
5*	1800	dual	Master-TEFC-BB
5	1800	220	Wagner TE-BB
5*	1200	dual	GE-TEFC-BB
3	3600	440	Wtg.-TE-BB
3	1800	dual	Delco-TEFC-BB
3	1200	dual	Rel.-TEFC-BB
2	1200	220	GE-TE-BB
2	900	220	Wagner-TE-BB
2	1800	dual	Delco-TEFC-BB
1½	900	dual	Delco-TEFC-BB
1½	1800	dual	L. Al.-TE-BB
1½	1200	dual	Ref-TEBB
1	3600	220	Haskins-TEFC
1	1800	dual	Master-TEFC-BB
1*	1800	dual	Delco-TE-BB
1*	1200	dual	Rel.-TE-BB
¾	3600	440	Delco-TE
¾	1800	dual	Wesche-TE-BB
½	3600	220	Ohio-TE-BB
½	1800	440	Wtg.-TE-BB
½*	1800	dual	Delco-TE-BB
½	1200	220	Cr.Wh.-TE
½	3600	440	GE-TE
½	1800	220	Delco-TE-BB
½	1800	440	Delco-TE-BB
½	1200	440	Wtg.-TE-BB

* New Motor

SLIP RING MOTORS

HP	RPM	Volts	Make
500	900	440	GE-3 Brg.
400	1200	2300	Al. Ch.
400	900	440	GE-IM
375	1800	2300	Al. Ch.
235	1800	220	GE-I
250	300	2300	Al. Ch.
200	514	440	Triumph-C
75	360	220	GE-I-M
60	1800	dual	Al. Ch.
60	900	2300	Burke
60	900	220	Wesche
50	900	2300	Ridgeway
50	900	440	Wagner
50	720	440	Al. Ch.
40	1200	220	Wtg.-CW
40	900	2300	Al. Ch.
40	900	220	Wtg.-HF
40	720	2300	Wtg.-HF
40	720	220	Al. Ch-ANY
40	600	2300	Al. Ch-ARY
40	600	220	Al. Ch.-ANY
40	450	220	Triumph-C
35	900	2300	Ridgeway
35	720	220	GE-I
30	1800	2300	Wtg.-CW
30	1200	2300	Lincoln
30	900	220	GE-MT
30	900	2300	Ridgeway
30	720	220	GE-I
30	600	2300	Al. Ch.-ARY
30	600	220	F. Morse-BV
30	1200	440	Wagner
25	1200	2300	Al. Ch.-ANY
25	900	220	GE-MT
25	720	dual	Watson-KH
25	600	220	Watson-KH
20	1800	440	Al. Ch.
20	900	2300	GE-I
20	885	440	Wtg.-HF

VERTICAL MOTORS

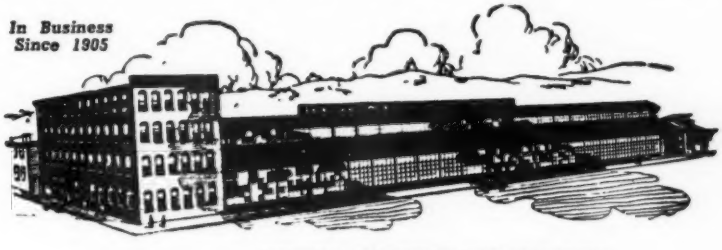
HP	RPM	Volts	Make
200	1200	440	Al. Ch.-SR
150	1200	2300	GE-SR
150	1200	440	GE-Cage
125	1200	2300	Al. Ch.-Cage
100	1200	440	GE-Cage
75	1200	2200	GE-Cage
75	360	220	Ideal-Cage
60	1800	230 D.C.	GE
60	1200	440	Al. Ch.-Cage
50	1800	440	GE-Cage
50	1200	2200	Wtg.-Cage
50	600	440	Al. Ch.-Cage
40	1800	220	GE-Cage
40	1700	230 D.C.	GE
40	1200	440	Wtg.-SR
40	1200	220	GE-Cage
40	950	230 D.C.	Wtg.
35	1800	440	GE-Cage
35	1200	2300	Al. Ch.-Cage
35	450	440	GE-Cage
30	1200	dual	Wtg.-Cage
25*	1550	230 D.C.	GE
25	1200	2200	GE-Cage
25	850	230 D.C.	Wtg.
20	1200	440	Al. Ch.-Cage

VERTICAL MOTORS—Cont'd

HP	RPM	Volts	Make
20	800	230 D.C.	GE
15*	1800	440	Al. Ch.-Cage
15	1750	110 D.C.	Wtg.
15	1150	230 D.C.	GE
15	600	440	Al. Ch.-Cage
12½	900	220	L. Al.-Cage
10	3400	230 D.C.	Wtg.
10	900	220	Wtg.-Cage
7½	1800	600 D.C.	Peerless
7½	900	440	Burke
7½	700	230 D.C.	GE-Cage
6	850	110 D.C.	Rel.
5	1400	230 D.C.	R. & M.
5	600	440	GE-Cage
4	1650	110 D.C.	Watson
3	1700	230 D.C.	Watson
3	1200	dual	Wtg.-Cage
3	900	440	Wtg.-Cage
3	600	dual	Wtg.-Cage
2	1800	230 D.C.	GE
2	1800	220	L. Al.-Cage
2	1180	230 D.C.	Wtg.
2	900	220	GE-Cage
1	1200	220	GE-Cage

SYNCHRONOUS MOTORS

HP	RPM	Volts	Make
1200	900	440	GE-ATI
710	720	13200/6600	GE-ATI
250	225	2200	GE
250	225	440	GE
200	225	2200	Wtg.
175	225	208	GE
160	600	440	GE
160	164	440	GE
125	150	440	GE
120	225	220	E-M
115	164	208	GE
60	360	2200	GE
50	360	440	GE
30	900	440	Wagner
30	720	440	GE
30	600	550	GE
30	450	dual	Wtg.
30	360	550	GE
30	327	220	E-M
25	1800	220	Wagner
25	450	220	E-M
25	300	220	Ideal
20	900	220	Wtg.
20	600	220	E-M
15	1800	220	Wagner
10	1800	220	Wagner
10	1200	220	Wagner
7½	1200	440	Wagner



TRANSFORMERS

General Electric Spirakore Transformers, 167 KVA, 2400/4160Y volt primary, 120/240 volt secondary, 1 phase, 60 cycle, oil cooled, outdoor type. Alternative same except secondary 240 or 480 volt.

DIRECT CURRENT GENERATORS

KW	Volts	RPM	Manufacturer	Description
400	120/940	300	Westinghouse	Compound, Interpole Pedestal Bearings
200	250	375	Jantz & Leist	Compound Wound, Pedestal Bearings
175	250	450	Westinghouse	Compound Wound, Pedestal Bearings
80	125	500	Jantz & Leist	Compound Wound, Double Shaft Extension
80	125	400	Jantz & Leist	Compound Wound, Double Shaft Extension
30	250	300	Triumph	Compound Wound
22½	250	765	Westinghouse	Compound Wound

MOTOR GENERATOR SETS

KW	Volts	Generator Mfgr.	A. C. Motor
500	600	General Electric	710 HP, 1 P.F., 720 RPM, 13200/6600 Volts, General Electric, Synchronous
*300	250	General Electric	450 HP, 1200 RPM, General Electric, Synchronous
200	230/250	Crocker-Wheeler	300 HP, 1 P.F., 600 RPM, 2300 Volts, Allis-Chalmers, Synchronous
200	125	General Electric	300 HP, 900 RPM, General Electric, Synchronous
50	120/125	Burke	95 HP, 1200 RPM, Burke, Synchronous
*50	115/230	Westinghouse	75 HP, 1800 RPM, Westinghouse, Induction
40	250	Reliance	60 HP, 1800 RPM Century, Induction
25	125	General Electric	35 HP, 1200 RPM, General Electric, Induction

* These Motor Generator Sets are unused.

AC & DC MOTORS • GENERATORS • PUMPS
SYNCHRONOUS MOTORS • CONTROL EQUIPMENT
MOTOR GENERATOR SETS • ELECTRIC EQUIPMENT
STEAM ENGINE GEN. SETS • SLIP RING MOTORS

933-943 HARRIET ST.
PHONE MA. 3024
CINCINNATI 3, OHIO

NEW *Never Installed*

SURFACE CONDENSERS

9300-Sq. Ft. to 100-Sq. Ft., Surface Type in Stock NEW
ALSO NEW CONDENSER AUXILIARIES
Circulating and Condensate Pumps, Air Evactors, Etc., Etc.

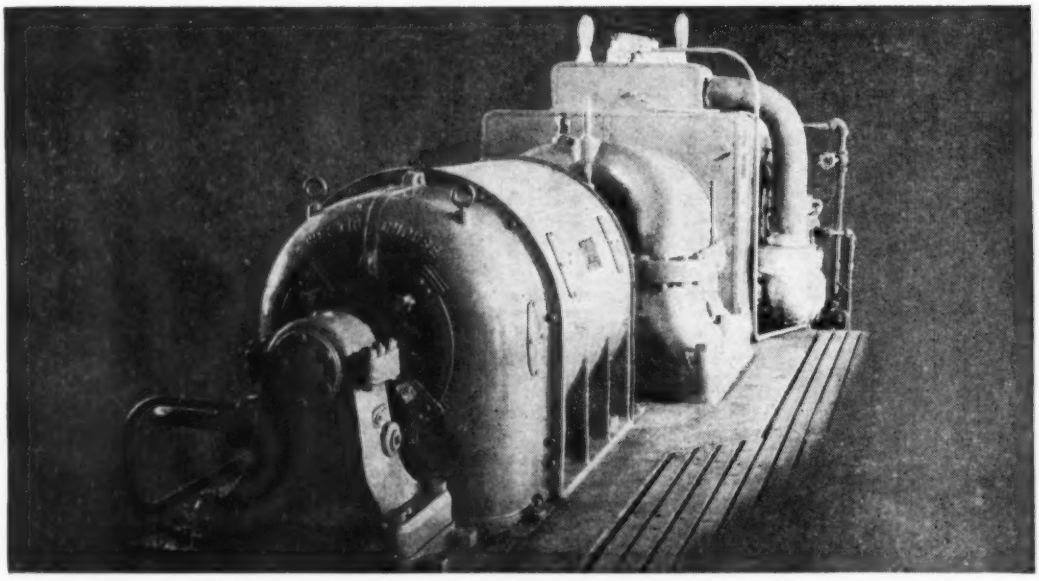
WE CAN SAVE YOU: 33⅓% TO 75%

OUR RECENT OUTRIGHT PURCHASE OF MANY THOUSANDS OF DOLLARS INCLUDES NEARLY EVERY ITEM USED IN POWER PLANT OPERATION

SPECIALS: 1—5000-KVA., G.E., 450#, 720 F.TT. 2300-volts
4—2250-KVA.,450#, 720 F.TT., 480-volts
2 of 2250-KVA., are Non-Condensing

TURBO-GENERATORS

NEW & USED
IMMEDIATE DELIVERY



Automatic Extraction, 625-KVA., Westinghouse Turbo-Generator 250#G. psi. 5/25# Extraction. Shaft Exciter Switchboard, Etc. Condition, Excellent

USED TURBO-GENERATORS: Partial List Only of Our Stock

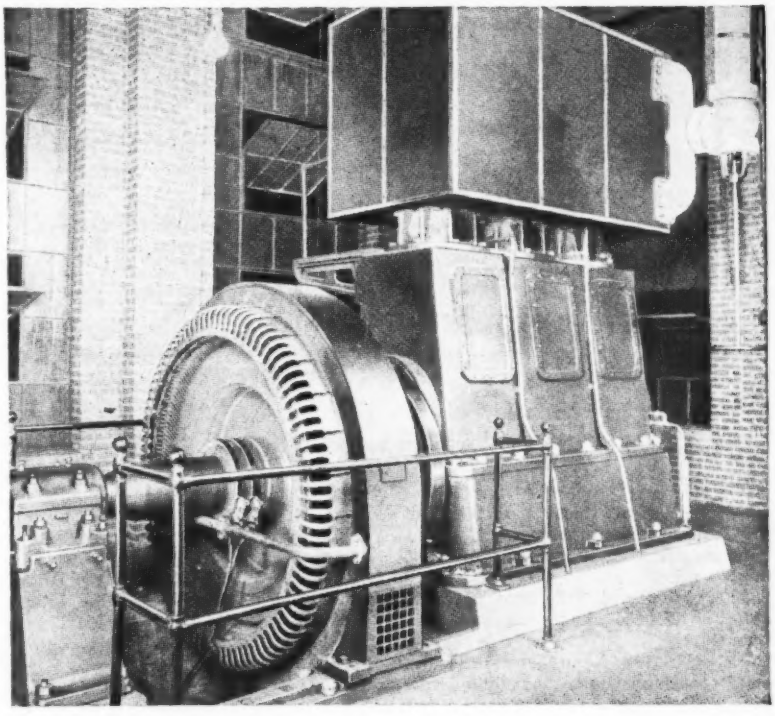
5000-KVA. 450#, 720°-F.TT., 2300-V.
7800-KVA. G.E. 250#, 2300-V., Sur. Condenser
5000-KVA. G.E. 200#, 100-Deg., 2300-V.
3750-KVA. G.E. 200#, 2300-V., Condensing
2500-KVA. West., 200#, 2300-V., (1-GE.)
2850-KVA. G.E., 450#, 720°-F.TT., 480-V.
2500-KVA. G.E., Aut. Extr., 200#-psi., 25#-B., 480-V.
1865-KVA. Elliott, 350#, 550-F.TT., 2300-V.
1865-KVA. G.E., Cond., 200#, 2300-V.
1865-KVA. G.E., Aut. Extr., 200#, 30#-Back, 2300-V.
1250-KVA. Allis-C. Non-Cond. 160#, 25-Back, 2300/
937-KVA. Moore-Allis, Non-Cond., 200#, 25#-Back
937-KVA. Allis-Chalmers Cond., 200#, 480-V.
625-KVA. West., Aut. Extr., 250#, 25#-Back, 480-V.
625-KVA. G.E., Non-Cond., 200#, 25#-Back, 2300-V.
500-KW., Several Good Units Available

Bulletins Nos. 205, 208, 249 — Free For the Asking: Write Today

CHARLES WEAVER & COMPANY

4045 Penobscot Building *ENGINEERS* Detroit 26, Michigan

POWER PLANT MACHINERY - IMMEDIATE DELIVERY



960 I.H.P., 18" diameter x 16" stroke, 3 cylinder, 327 RPM Skinner Vertical Unaflow non-condensing engine, 150 lbs. pressure direct connected to a 750 KVA—600 KW, 80% P.F., 40° C rise, 3 phase, 60 cycle, 2300/600/480/240/208 volts 327 RPM Electric Machinery alternating current generator equipped with a 15 KW, 125 volt, 1450 RPM V-belt Electric Machinery Exciter, Switchboard panel with instruments and General Electric voltage regulator.

← ACTUAL PHOTOGRAPH

EXCELLENT CONDITION

COMPLETE INSTALLATION

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

3750 KVA G.E. 250 lbs. pressure, 4160 volts 3600 RPM complete surface condenser.

2500 KVA Westinghouse condensing 180 lbs. pressure, 2300 volts, 3600 RPM complete surface condenser, exciter.

1875 KVA Westinghouse non-condensing 150 lbs. pressure, 15 lbs., back, 480 volts, 3600 RPM complete with switchboard.

1250 KVA G.E. condensing, 200 lbs. pressure, 2300 volt, 3600 RPM complete exciter, condenser, panel.

625 KVA G.E. non-condensing 150 lbs. pressure, 15 lbs. back, 2300 volts, 3600 RPM complete exciter, panel.

625 KVA Westinghouse automatic bleeder condensing, 250 lbs. pressure, 20 lbs. gauge, 480 volts, complete condenser.

500 KVA Westinghouse non-condensing 150 lbs. pressure, 10 lbs. back 240 volt, complete exciter and switchboard.

375 KVA G.E. cendensing, 125 lbs. pressure, 2300 volt, 3600 RPM complete surface condenser and panel.

125 KVA Westinghouse non-condensing, 175 to 200 lbs. pressure, 0-10 lbs. back, 240 volts with exciter, panel.

125 KVA G.E. non-condensing, 175 to 200 lbs. pressure, 10 lbs. gauge back, 2300 volts, 3600 RPM complete.

100 KVA Westinghouse non-condensing, 125 to 150 lbs. pressure, 10 lbs. gauge back 2400/600 volts, 3600 RPM.

ENGINE-GENERATOR UNITS

ALTERNATING CURRENT—3 phase, 60 cycle

750 KVA G.E. 2300 volts 150 RPM generator direct connected 28"x32" Chuse Uniflow engine.

500 KVA Westinghouse 600 volt, 514 RPM Generator.

375 KVA G.E. 2300/480 volt, 180 RPM Generator direct connected to 21"x24" Chuse non-releasing Engine.

225 KVA E.M. 2300 volts, 200 RPM generator direct connected to 19"x24" Chuse Unaflow poppet valve engine.

187 KVA G.E. 2300 volt, 225 RPM Generator direct connected to 15"x19" Chuse non-releasing Engine.

180 KVA G.E. 240/440 or 550 volts, 200 RPM generator direct connected to 18"x21" Chuse non-releasing Corliss engine.

ENGINE-GENERATOR UNITS DIRECT CURRENT

1000 KW Westinghouse 250 volt, 514 RPM Generator direct connected to 3600 RPM Westinghouse bleeder condensing turbine.

400 KW Maximum, Crocker Wheeler 125 volt, 300 RPM Generator direct connected to Skinner Unaflow Engine.

200 KW Burke 3-wire, 250 volt, 360 RPM generator direct connected Ames 4 cylinder vertical Unaflow non-condensing engine, 150 lbs. pressure complete switchboard.

75 KW Allis Chalmers-Terry, 125 volts, 2400 RPM 150 lbs. pressure non-condensing turbine generator unit.

60 KW *New* Westinghouse 120 volt Marine type turbine generator units (3).

35 KW G.E. 125 volts, turbine-generator unit.

MOTOR GENERATOR SETS

1500 KW Allis-Chalmers 550/600 volts, 300 RPM direct current generator direct connected 2190 HP, 3 phase, 60 cycle, 4000/6600 volts synchronous motor.

500 KW Allis 250 volt, 1200 RPM direct current Generator direct connected to 3 phase, 60 cycle, 4000 volts Synchronous Motor.

500 KW Allis 250 Volt, 720 RPM direct current Generator direct connected 3 phase, 60 cycle, 2300 volt Synchronous Motor.

300 KW Allis 250 volt, 600 RPM direct connected 3 phase, 60 cycle, 4000/2300 volts Synchronous Motor.

62½ KVA G.E. 3 phase 60 cycle, 2300 volts, 1200 RPM alternator direct connected 75 HP, 115 volts direct current motor.

50 KW Westinghouse, 125 volt, direct current generator direct connected 75 HP, 3 phase, 60 cycle, 2300 volt motor.

Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BLDG.
CLEVELAND 14, OHIO

WIRE OR PHONE
LONG DISTANCE 422

LIQUIDATION SALE—Modern Equipment

DIESEL ENGINES

	Make	Model	H.P.	R.P.M.	Cycle	Cylinders	Bore & Stoke	Year	Reverse & Reduction Gear
4	General Motors	16-268S	1800	900	4	16	9½" × 12"	1943	2.41:1 (fluid coupling)
2	Hamilton	R.B.99-D.A.	1600	700	2	9	9½" × 13⅜"	1944	
2	General Motors	12-278A	1200	750	2	12	8¾" × 10½"	1944	Falk 2.5:1
35	General Motors	12-567ATL	900	744	2	12	8½" × 10"	1942-44	Falk 2.5:1
2	General Motors	8-268A	500	1200	2	8	6½" × 7"	1943	2.54:1
2	Fairbanks Morse	38 O/P	300	1200	2	6	5" × 6"	1936	
4	Buda	6LD468	95	1850	4	6	4¼" × 5½"		

A. C. DIESEL GENERATOR SETS

									KW	Volts	Cycles	Phase	Make of Generator	DC Generator KW	DC Generator Volt
3	General Motors	8-268A	350	1200	2	8	6½" × 7"	1943	200	440	60	3	Westinghouse	40	120/240
1	General Motors	3-268A	150	1200	2	3	6½" × 7"	1943	100	440	60	3	Century	2	120
1	Fairbanks Morse	36A	110	1200	4	8	8½" × 7½"	1936	80	450	60	3	Fairbanks Morse	3	120

D. C. DIESEL GENERATOR SETS

7	General Motors	16-278A	1600	750	2	16	8¾" × 10½"	1943	1200	525 DC	Allis Chalmers Type MHC 2290 AMPS
2	General Motors	8-268A	500	1200	2	8	6½" × 7"	1944	375	120/180/240 DC	Westinghouse
80	Superior	GDB-8	150	1200	4	8	5½" × 7"	1942-44	100	120/240 DC	Delco Model T362 3 wire stab. shunt 60° C rise 417 AMPS
2	General Motors	3-268A	150	1200	2	3	6½" × 7"	1943-44	100	120/240 DC	Allis Chalmers
1	Fairbanks Morse	36A5½DE	100	1000	4	6	5½" × 7½"	1943	60	225 DC	F.M. Type DGZH compd. wd. 267 AMPS
1	Caterpillar	D3400	26	1500	4	4	3¾" × 5"	1942	15	120/240 DC	General Electric Model 52A1990 compd. wd.

BOILERS

6—Express Boilers, modified D type, Foster Wheeler, 30,000# steam/hr., 435# press., with economizers, superheaters, desuperheaters, oil burners, etc.

2—Boilers, single pass., header-type, Babcock & Wilcox, built 1941, 22500# steam/hr., at 250# press.

2—Wickes Boilers 628 H.P. 3 drum, 250 pounds pressure.

8—B&W, D type, 580# press., 5400 sq. ft. heating surface. (3 are new)

1—B&W, stationary boiler, 40,000# steam per hour, 1000-1500# press. (complete installation, unused).

6—Cyclotherm 3000 pounds steam per hour, 125# press.

10—Cleaver-Brooks, 2000# steam pr. hr. 35# press.

TURBO-GENERATORS

6—300 KW G.E. type ATI 3/60/450, 1200 RPM cond., compl. with 40 KW exciters, condensers, switchboards.

2—200 KW Westinghouse, 3/60/450, 1200 RPM cond. (NEW).

8—200 KW, G.E. type ATB 3/60/450, 1200 RPM, cond. and non-cond.

2—132 KW G.E. type ATB 3/60/450, 1200 RPM, cond.

2—375 KW West'hse 180/240 V, DC, 3000 Amp, 1200 RPM, cond.

12—150 KW West'hse type SK, 120 V, DC, 1200 RPM, cond.

20—60 KW West'hse type SK, 120 V, DC, 1800 RPM cond.

NOTE—MANY GENERATORS FOR SALE SEPARATELY WITHOUT TURBINES

CONDENSERS—(New)

10—3800 sq ft ⅝" copper nickel tubes

DISTILLING PLANTS

2—40,000 gallons per day, Foster Wheeler triple effect low pressure

1—80 tons per day, Condenser Service, double effect

4—8000 gals. per day Griscom Russell Soloshell double effect complete with pumps

3—5000 gals. per day, Cleaver Brooks self contained units complete with pumps and fans

10—2000 gals. per day Kleinschmidt vapor compression distiller mfd. by Badger.

1—750 gals. per day, same as above.

MOTORS

G.E., 6000 HP 3/93⅓/2700 V 400 RPM or 3800 HP 3/60/1700 V 257 RPM.

HOISTS

10—Main drum 100,000# pull at 10 FPM to 3000# pull at 400 FPM, 2 Gypsies 12,000# pull at 125 FPM, driven by 50 HP 230v. D.C. motors 525—1800 RPM.

15—Main drum 15,000# pull at 78 FPM, 3360# pull at 348 FPM and 2 auxiliary drums. Driven by Chrysler 28.35 H.P. gasoline engines. (NEW).

AIR COMPRESSOR

1—8000 CFM, dischgr press. 100# Ingersoll-Rand, turbine driven.

MOTORS

1500 HP 525 V DC 600 RPM W'hse

GENERATORS

1200 KW 525 V DC 750 RPM All. Chalm.
1122 KW 400 V DC 720 RPM Elliott
1075 KW 375 V DC 750 RPM Elliott

Note: These motors and generators suitable for operation at lower voltage.

AIR COOLERS—HEATERS

Single section, 2 pass, double tube type

10—1860 sq. ft. surface, Westinghouse
17—1670 sq. ft. surface, General Electric
7—1290 sq. ft. surface, Westinghouse

For Cooling, Drying and Air Conditioning

TRANSFORMERS

10—50 KVA
10—25 KVA
10—20 KVA
10—15 KVA
} from 440 V to 120 V, all single phase, 60 cycle, dry type

REDUCTION GEARS

4—1800 HP 2.41:1
10— 900 HP 2.48
10— 25 HP 20:1
10—20 HP 41:1
10—11 HP 39:1
10—10 HP 1750:63
7—Waterbury hydr, type K, size 35, 5 and 2A

MISCELLANEOUS

MOTORS	AC 440 V and 2200 V	From 5 HP to 350 HP.
MOTORS	DC 115, 230 and 525 V	From 3 HP to 1500 HP.
MOTOR-GENERATORS	AC:DC and DC:AC	From 3 KW to 60 KW.
PUMPS	Up to 15000 GPM	Up to 725# press.
CENTRIFUGES	Sharples and DeLaval	100 GPH and 150 GPH.
TURBO-BLOWERS	15600/20000 CFM	From 17" S.P. to 18.5" S.P.
FANS	AC and DC motor drive	From 2000 CFM to 15000 CFM.
AIR COMPRESSOR	High pressure	From 700# to 3000# press.
FEED WATER HEATERS	High and low press	Up to 263 sq. ft.
ICE PLANTS	Motor and steam driven	From ½ ton to 22 tons.
CONDENSER TUBES	(NEW) Cupro Nickel	⅝" OD, 18 gauge.
BLAST CABINETS	Pangborne	For Sandblasting.
WIRE ROPE SLINGS	Various Sizes	Large Quantities

7—BLOWERS (Roots Connersville) size 16" x 18", connected to G.E. induction motors 200 H.P., 3 phase 60 cycle, 2200 Volt, 705 RPM

2—BLOWERS (Roots Connersville) size 20" x 23" connected to Westinghouse Electric induction motor 350 H.P., 3 phase 60 cycle, 2200 Volt, 590 RPM

(Blower Motors also sold separately.)

WRITE OR CALL FOR DETAILS

HUGO NEU CORPORATION

31 Nassau Street New York 5, N. Y.

Tel.: REctor 2-1334

ARRANGE FOR INSPECTION

BOILERS

SPECIAL

Pair of 406 HP Heine Boilers, built 1926, 2 longitudinal drums each; 180# Insurance Company approved, ASME, good condition, can be shipped intact, with water columns, valves, soot blowers, and all trim except stokers.

300 HP 200# 20/30000#/hr. ASME, Wickes, 3 drum low head, water walls, NEW, never installed

30/35000#/hr 425# ASME, Bros Co., Integral Furnace, water walls, NEW, never installed

750 HP, 250#, ASME, Pa. Std., Union Iron Works, 1927 4-drum, stoker, stack, controls, etc.

2 Million b.t.u., DOWTHERM unit, Foster-Wheeler 150# design pressure, oil fired. Built about 1940, complete

250,000 b.t.u., DOWTHERM unit, Foster-Wheeler, 150# design pressure, gas fired, built about 1940. Complete.

MG SETS

(With Controls)

275 V. 500 KW—60/3/2300, 514 RPM, G.E. Synch. Motor #86000, Gen. #114000 (250 KW each).

250 V. 600 KW—60/3/480, 1200 RPM, G.E. Synch. Motor, 2-300 KW Gen. Rebuilt and guaranteed.

600 V. 500 KW—60/3/2300, 720 RPM, Wemco Synch. Motor #808,900, Gen. #808,900.

550 V.1000 KW—60/3/4000, 720 RPM, G.E. Synch. Motor #1012000, Gen. #434000.

600 V. 1000 KW—60/3/11000, 900 RPM, Wemco Synch. Motor #4323100, Gen. #4323100.

ROTARIES

(With Transformers and Controls)

575 V. 500 KW—60/3/11000, 600 RPM, Four Units, GE #134000.

575 V. 500 KW—60/3/11000, 1200 RPM, GE #1423900.

600 V. 1000 KW—60/3/9900/11000, 360 RPM GE #477000.

575 V. 300 KW—60/3/11000, 900 RPM, GE #134000.

600 V. 1500 KW—60/3/4000, 720 RPM Wemco #4573900. Transformers can be rewound for 13200 V.

FURNACE TRANSFORMERS

60/3

34 KV—220/85 1000 KVA GE rebuilt, no switchgear.

34 KV—164/133 1000 KVA A/C.

22 KV—228/92 4000 KVA Penn, new, built 1942.

22 KV—260/101 4000 KVA Penn, built 1942, no switchgear.

13 KV—240/95 5000 KVA Wemco, built 1942.

13 KV—239/85 4000 KVA Penn, built 1940.

13 KV—239/85 3000 KVA Wemco, about 1940.

13 KV—239/85 2000 KVA Penn, about 1941.

13 KV—124/55 1000 KVA Pitt, rebuilt and guaranteed.

12/6 KV—224/128 2-150 KVA (1 Ph) Elec. Furn. 10% & Scott taps.

12 KV—200 1500 KVA Pitt, rebuilt 1946.

4600 V—187/75 200 KVA Penn, about 1937.

230 V—120/60 200 KVA Wemco, new, built 1938.

POWER & DISTRIBUTION TRANSFORMERS

60/3

33 KV—3300 V, 2-300, 2-150 KVA, can rewind secondary.

26.4 KV—13.2 KV, 2-8000 KVA (Auto).

11/22 KV—3300 V, 2-300, 2-150 KVA, can rewind secondary.

11/9.9 KV—480 V, 1500 KVA.

480 V—12 V, 3-150 KVA, 9 LV taps 10/20.

60/1

33 KV—2300 V, 3-750 KVA, water cooled.

22 KV—2300/4000, 3-3000 KVA, rebuilt.

11/9 KV—2300, 3-1000 KVA, old but serviceable.

11 KV—2300, 3-125 KVA reconditioned.

2400/4160 V—120/240, 3-167 KVA, new.

2400/4160 V—480, 3-167 KVA, new.

TURBO-GENERATORS

60/3, Condensing

1000 KW Wemco 2300 V 175# 1921.

1500 KW GE 2300 V 150# 1916.

2—750 KW GE 2300 V 150# approx. 1914.

6000 KW GE 600/6600 V 175# 1916.

1000 KW GE 600 V 235# 1925.

200 KW Wemco 480 V 150# 1924.

500 KW Terry 240 V 175# (#7500).

TURBO-GENERATORS

60/3, Non-Condensing

1500 KW Wemco 2300/4000 200#-12# 1912.

500 KW GE 2300 V 150#-10# 1919.

TURBO-GENERATORS

60/3, Extraction Condensing

2000 KW GE 550 V 225#-20# 1923.

480 KW Moore 480 V 150#-20# 1928.

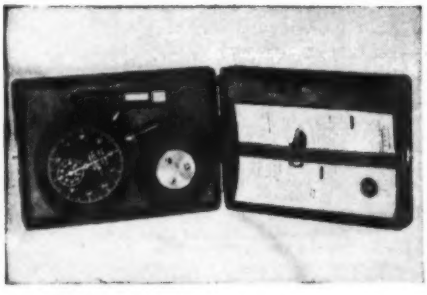
PAUL STEWART & CO., INC.

UNION TRUST BUILDING **CINCINNATI 2, OHIO**

Over 50 Years of Service

PORTABLE CHRONOMETRIC TACHOMETER

$24.50



JAEGER WATCH CO. MODEL #43A-6

CAN BE USED FOR SPEEDS UP TO 20,000 R.P.M.

CAN BE USED FOR LINEAL SPEED MEASUREMENTS TO 10,000 F.P.M.

IDEALLY SUITED FOR TESTING THE SPEEDS OF MOTORS, PARTICULARLY OF FRACTIONAL HORSE POWER, GENERATORS, TURBINES, CENTRIFUGALS, FANS, ETC.

VERY SMALL TORQUE—Requires Practically no Power to Drive.

UNEQUALLED READABILITY 2" OPEN FACE DIAL—EACH DIVISION ON LARGE DIAL EQUALS 10 R.P.M.; EACH DIVISION ON SMALL DIAL EQUALS 1,000 R.P.M.

GREATEST ACCURACY — Meets Navy Specifications — Guaranteed to be within ½ of 1%.

RESULTS OF TEST READING REMAIN ON DIAL UNTIL NEXT TEST IS TAKEN.

PUSH BUTTON FOR AUTOMATIC RESETTING.

COMPLETE WITH THE FOLLOWING ACCESSORIES:
- 1—LARGE POINTED RUBBER TIP
- 1—LARGE HOLLOW RUBBER TIP
- 1—6" CIRCUMFERENCE WHEEL TIP
- 1—OPERATING INSTRUCTIONS
- 1—TEMPERATURE CORRECTION CHART

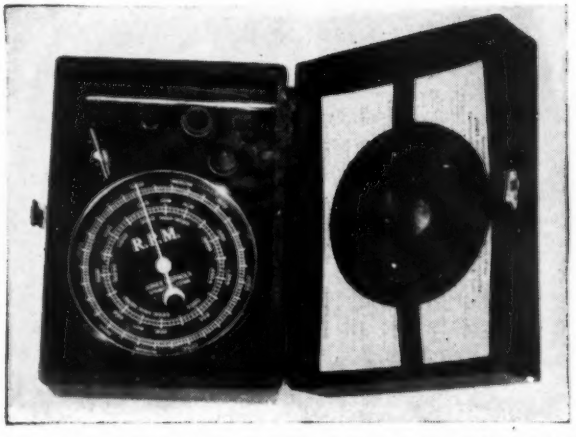
The combination of the above features will give accurately, within a few seconds, by direct reading, the R.P.M. of shafts or the lineal speeds of surfaces without any accessories or timing of any kind. Each unit comes complete in a red velvet lined carrying case 5" x 3½" x 1½". NET LIST PRICE $75.00—SURPLUS—NEW—GUARANTEED.

YOUR COST $24.50 FOB, NEW YORK

Multiple Range Continuous Indicating PORTABLE TACHOMETER

$24.50

2/3 Actual Size



This unit is of the centrifugal mechanical type and is designed to show instantaneously and continuously the speed or change in speed of any revolving shaft or surface. No stop watch or other mechanism required.

Three Ranges in R.P.M. and Three Ranges in F.P.M.
- LOW RANGE 300- 1,200
- (Each Division Equals 10 R.P.M.)
- MEDIUM RANGE 1,000- 4,000
- (Each Division Equals 20 R.P.M.)
- HIGH RANGE 3,000-12,000
- (Each Division Equals 100 R.P.M.)

LARGE OPEN DIAL 4" DIAMETER.

RUGGEDLY CONSTRUCTED For Heavy Duty Service.

BALL BEARING AND OILLESS BEARINGS — Require No Lubrication Whatsoever.

READILY PORTABLE—Fits Neatly Into Palm of Hand.

GEAR SHIFT FOR SELECTING LOW, Medium and High Ranges.

GREATEST ACCURACY — Meets Navy Specifications 18-T-22, Type B, Class A.

COMPLETE WITH THE FOLLOWING ACCESSORIES:
- 1—STEEL TIP
- 1—CONICAL RUBBER TIP Metal Mounted
- 1—RUBBER LINED Metal Cone Tip
- 1—PERIPHERAL RUBBER WHEEL 1 Ft. in Circumferance
- 1—EXTENSION ROD
- 1—SMALL SIZE CONVEX RUBBER TIP, Metal Mounted
- 1—OPERATING INSTRUCTION

MADE BY JONES MOTROLA, STAMFORD, CONNECTICUT. Comes Complete in Blue Velvet Lined Carrying Case: 7⅛" L x 4" H x 5" W. LIST PRICE $75.00—SURPLUS—NEW—GUARANTEED.

YOUR COST $24.50 FOB, NEW YORK

All items are Surplus-New-Guaranteed. C.O.D.'s not sent unless accompanied by 25% Deposit. Orders accepted from rated concerns, public institutions, etc., on open account. We carry a complete line of surplus new meters suitable for every requirement, such as portable, panel, switchboard, recording instruments, laboratory standards, etc. Over 50,000 Meters in Stock. We also stock various surplus components, tubes, parts, and accessories and can supply large quantities for manufacturers, exporters, etc. Send for free circular Manufacturers, Exporters, Dealers—we invite your inquiries.

MARITIME SWITCHBOARD

338 Canal Street . . . . . Worth 4-8217 . . . . . New York 13, New York

WAGNER

"CERTIFIED REBUILT"

FOR MORE THAN 40 YEARS
THE MARK OF DEPENDABLE ELECTRICAL EQUIPMENT

MOTORS . . . GENERATORS . . . M-G SETS

PUMPS . . . FANS . . . BLOWERS . . . SPEED REDUCERS

PARTIAL LISTINGS—WRITE, WIRE OR PHONE YOUR REQUIREMENTS

M-G SETS

KW	Mfr.	Input V.	Output V
300	Gen. Elec.*	220/440 AC	230 DC
200	Gen. Elec.*	2200 AC	125 DC
150	Gen. Elec.	220/440 AC	125 DC
105	Century b.b.	220/440 AC	70 DC
80	El. Prod.*	220/440 AC	125/250 DC
75	Gen. Elec.*	220/440 AC	250 DC
50	Cr. Wheeler	220/440 AC	250 DC
37½	Whse.	230 DC	3 ph. 240 AC
35	Gen. Elec.	220/440 AC	48 DC
30	Marble Card	220/440 AC	60 DC
30	Elec. Prod.*	220/440 AC	50 DC
25	G.E. NEW	220/440 AC	125 DC
9	H.V.W. 1500 amp.	220/440 AC	6/12 DC

*Synch. motor drive.

D. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
100/150	G.E. dynamom.	TLC	25	1000/3500
80/125	Gen. Elec.	C100	230	500/1000
75	Whse.	813L	115	575
75	Gen. Elec.	BRC	115	1150
65	Gen. Elec.	C	230	375/750
60	Diehl dynamom.	R10	250	500/2000
60	G.E. bb (2)	CDM103	230	1750
50	Cr. Wheeler (2)	50H	230	700
40	Reliance (2)	310T	230	625/1200
40	Gen. Elec.	RC31	230	1750
35/50	Gen. Elec.	CD123	230	575/1150
45	P&H crane (2)	14X	500	440
30	Whse.	S-7	115	900
25	Sprague dyna.	LC	230	750/2000
25	Chand'son (4)	C13	115	850
25	Roth	RS	230	1750
25	G.E. bb NEW	CDM93	115	1150
20	G.E. bb NEW	CDM83	115	1750
20	Gen. Elec.	RCP29	230	1750
20	Gen. Elec.	RC11	115	1150
20	Reliance	T	230	850
20	Gen. Elec.	LC	230	575
20	Gen Elec.	DLC	230	500/1500
15	Roth	85RS	230	1750
15	G.E. bb NEW (2)	CDM67	115	1750
15	Gen. Elec.	RC10	230	1150
15	Whse. (5)	SK90	230	825
15	Gen. Elec.	CD95	230	550/1650

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	G.E. 1 brg.	MPC	125/170	1150
105	Century b.b.	1500a.	70	1200
100	G.E.	TLC	250	1150
80	G.E.	C100	250	600
75	Whse.	S	125	600
50	Gen, Elec.	CL	250	750
50	Cr. Wheeler	CCD	250	850
24	Whse.	SK	600	850
25	G.E. NEW b.b.	CD93	125	1450
20	Allis Ch.		125	475
12	Engberg b.b.	MR	250	1150
15	Gen. Elec.	RC	125	1200

SPECIAL—FREQUENCY CHANGER

125 KW G.E. ITT565 changer 25/60 cycle 440V. coupled to 100 HP. KT559 motor 3/25/440V. 750 RPM.

EXPLOSION PROOF MOTORS—NEW

2—3 HP 1200 RPM	1—10 HP 900 RPM
3—7½ HP 1800 RPM	1—15 HP 1800 RPM
1—7½ HP 900 RPM	2—20 HP 1800 RPM

A. C. GENERATORS

KVA	Mfr.	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
500	Allis Ch.	3 brg.	240/480	360
250	Whse.	G	2300	600
150	Allis Ch.	B	2300	900
125	Gen. Elec.	ATB	240/480	300
100	Cr. Wheeler		2300	900
75	Triumph	A15L	240/480	900
60	El. Machy.		240/480	900
50	Cont. b.b.	S107	120/208	1200
25	Whse. b.b. (3)	1 phase	120	900
12½	Whse. b.b. NEW		240	1200

A. C. MOTORS—SLIP RING

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	400	G.E. 3 brg.	I-P	450
1—	300	G.E. 2200V.	I-M	1800
1—	300	Gen. Elec.	MT365	1200
1—	200	Gen. Elec.	IM-E13B	1800
1—	200	Whse. 3 brg.	HF	600
1—	200	G.E. 2200V.	IM-15A	720
2—	150	G.E. int.	ITC5015	720
1—	100	Whse.	CW761C	1800
2—	100	Gen. Elec.	IM-15	720
1—	75	Gen. Elec.	IM-14	600
1—	75	Gen. Elec.	MT337	1800
1—	50	Fair. Morse	BV	720
1—	50	Gen. Elec. int.	ITC	600
1—	50	Whse. int.	CI	600
2—	40	Gen. Elec.	MT336	900
1—	40	Allis Ch.	ANY	450
1—	37	G.E. int.	ITC	600
1—	35	Lancashire	b.b.	1800
1—	30	Gen. Elec.	OMT336	1200
1—	30	Gen. Elec.	MT526	1200
1—	30	Gen. Elec.	MT346	600
2—	25	Gen. Elec.	I-M	1200
1—	25	Triumph	SR	1200
1—	25	Gen. Elec.	I-M	600
1—	20	P&H b.b. int.	WT8	1200
1—	15	Watson	KHV	720
1—	15	P&H b.b. int.	W7	1200

A. C. MOTORS—25 CYCLE

H.P.	Mfr.	Type	Volts	Speed
150	Whse.	C	440	500
150	Whse.	HF	440	500
50	G.E. int.	MTC5337	440	750
50	Allis Ch.	ANY	440	1500
25	Howell	SR	440	750

1000 NEW MOTORS IN STOCK

A.C. 1 ph. & 3 ph.—Fract. H.P. up to 60 H.P.—All speeds, open & enclosed—standard makes—quantity discount.

A. C. MOTORS—SYNCHRONOUS

H.P.	Mfr.	Type	Volts	Speed
667	Gen. Elec.	ATI	2200	450
300	Whse.	G	2200	600
300	El. Machy.	late	2200	360
275	Whse.	G	2200	900
200	G.E. 25 cycle	ATI	220/440	500
150	Whse.	late	220/440	1800
150	Gen. Elec.	ATI	220/440	300
125	G.E. splprf.	TS955	220/440	1200
110	El. Machy.	BRKT	220/440	1200
75	E. Prod. b.b.	.8PF	2200	1200
75	El. Machy.	BRKT	550	900

A. C. MOTORS—SQUIRREL CAGE

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	250	G.E. 2200V.	I-K	600
1—	250	Gen. Elec.	KT559	1800
2—	200	G.E 2200V.	KTP559	1200
1—	200	Gen. Elec.	I-K	514
1—	150	Reliance b.b. encl.	AA	900
2—	150	Fair. Morse	B	600
2—	125	Allis Ch. b.b.	AR	450
1—	125	Cont. 2200V. b.b.	SC	1800
1—	125	Northwn.	H	1800
1—	125	Cr. Wheeler	125Q	900
1—	100	Whse. vertical	CS	1200
1—	100	Gen. Elec.	I-K	600
1—	75	Gen. Elec.	KT329Y	3600
1—	75	Gen. Elec.	KT352	900
1—	75	Gen. El. 2200 V.	I-L	720
1—	75	G.E. 2200V.	I-K	514
1—	60	Allis Ch. 4000/2200V.	AR623	1800
1—	60	Howell b.b.	SC416	1800
2—	60	G.E. NEW b.b.	K444S	1800
4—	60	Gen. Elec.	K505	1200
1—	60	Ideal	A306	1200
2—	50	G.E. NEW b.b. HT	KG405	1800
1—	50	Whse. spl. b.b.	CS445	1800
1—	50	G.E. NEW hitorq	KG445	1200
2—	50	Gen. Elec.	K505	900
1—	50	Gen. Elec.	KT342	900
2—	50	Whse. vertical	CS766	900
1—	50	Reliance b.b.	C5084	720
1—	40	Al. Ch. 3 speed	ARX	900/600/450
2—	40	G.E. NEW b.b.	K404	1800
1—	40	Gen. Elec.	I-K	1200
6—	40	Gen. Elec.	KT336	900
2—	35	Gen. Elec.	I-K	720
2—	35	Gen Elec.	I-K	900
2—	30	Howell b.b. 4 spd.	SC	1800
2—	30	G.E. NEW b.b.	K365	1800
2—	30	G.E. NEW hitorq	KG365	1800
2—	30	Whse. NEW b.b.	CS405	1200
2—	30	G.E. TEFC b.b.	K404	1800
1—	30	Gen. Elec.	I-K	900
1—	30	Gen. Elec.	KT336	720
1—	30	Whse.	CCL	600
1—	30	Wagner	22T8P	900
1—	25	Diehl NEW b.b.	IN404	1200
2—	25	Whse. NEW spl. b.b.	CS365	1800
1—	25	Allis Ch.	AN	1800
1—	25	Gen. Elec.	IK	1200
1—	25	Wagner	19TBW	1200
1—	25	Allis Ch.	AN	1200
1—	25	Gen. Elec.	KT526	900
4—	25	Whse.	CS646	900
2—	25	Gen. Elec.	I-K	600
2—	20	U.S. NEW b.b.	SC326	3600
1—	20	Gen. Elec.	KT182	3600
3—	20	G.E. NEW hitorq	KG364	1800
2—	20	G.E. NEW b.b.	K364	1800
2—	20	Delco NEW TEFC	C364	1800
3—	20	Whse. NEW b.b. spl.	CS364	1800
2—	20	Gen. Elec.	KT312	1200
2—	20	Gen. Elec.	I-K	1200
1—	20	Whse.	CS	1200
1—	20	Gen. Elec. b.b	I-K	900
1—	20	Fair. Morse	BH	900
1—	20	Gen. Elec.	IK	720
4—	15	G.E. NEW b.b.	K324	3600
2—	15	Whse. NEW b.b.	CS326	1800
2—	15	Diehl NEW b.b.	D1326	1800
2—	15	Whse. NEW TEFC	CS326	1800
2—	15	Whse. NEW b.b.	CS364	1200
2—	15	Diehl TEFC NEW	INF 365	1200
2—	15	Gen Elec.	KT954	1800
2—	15	G.E. spl. b.b.	K365	1200
4—	15	Gen. Elec.	KT302	1200
1—	15	Gen. Elec.	KT512	900
1—	15	L. Allis	OX365	900
1—	15	Gen. Elec.	I-K	720

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TURBINE UNITS—60 Cy.

2—6250 KW Gen. Elec. Cond. 25 Cycle
1—6000 KW General Electric Cond.
1—5000 KVA General Electric Cond.
1—4000 KW General Electric Cond.
2—3750 KVA Westinghouse Cond.
1—3750 KVA Westinghouse Extrac.
1—3125 KVA General Electric Cond.
2—1250 KVA General Electric Cond.
2—1250 KVA Elliott Cond.
1— 225 KVA General Electric Non-C.

STEAM ENGINE UNITS—60 Cy.

1—900 KW Hamilton Uniflow
1—750 KVA Chuse Uniflow
1—500 KVA Nordberg
1—450 KVA Ames Uniflow
1—375 KVA Harrisburg Uniflow
1—312 KVA Corliss
1—225 KVA Skinner Uniflow
1—187 KVA Ames Vertical
1—156 KVA Ames Vertical
1—150 KVA Harrisburg 4 valve
1—125 KVA Ames Uniflow

D. C. STEAM ENGINE UNITS

1—600 KW Ames Uniflow, 250 V.
1—600 KW Skinner Uniflow, 250 V.
1—500 KW Ames Uniflow, 250 V.
1—400 KW Ames Uniflow, 250 V.
1—350 KW Ridgway Uniflow, 250 V.
1—300 KW Skinner Uniflow, 275 V.
1—275 KW Ames Uniflow, 250 V.

DIESEL ENGINE UNITS

6—1600 HP Gen. Motors, 2400 V. 60 cy. gen.
3—1200 HP Hamilton 2300/4000 V. 60 cy. gen.
1— 720 HP Amer. Loco. 2400 V. DC
1— 625 HP Worthington, 240 V. 60 cy. gen.
1— 480 HP Fairbanks Morse, 2400 V. 60 cy. gen.
3— 425 HP Gen. Elec. 440 V. 60 cy.
1— 400 HP Fairbanks Morse 2300 V. 60 cy.
3— 360 HP Gen. Motors 440 V. 60 cy.
2— 30 KW Buda 6DTG-317, 3-60-127/220 V.

WATER TUBE BOILERS

1—1409 HP, B. & W., 650-lb. Stoker
2— 748 HP Edgemoor 250-lb. Stokers
1— 519 HP Titusville 200-lb. Stoker
6— 509 HP B. & W., 200-lb. Stokers
5— 492 HP Heine, 180-lb. Stokers
2— 469 HP, B. & W. 425-lb. Pulverizer

SYNCHRONOUS MOTORS

4—6000 HP, G. E. 60 cy. 2300 V. 90 RPM
2—2000 HP West. 60 cy. 2200 V. 120 RPM
1—1750 HP West. 60 cy. 2300 V. 240 RPM
1— 880 HP G. E. 60 cy. 2300 V. 514 RPM
1— 500 HP, G. E. 2200 V. 60 cy. 720 RPM
1— 350 HP G. E. 60 cy. 2200 V. 720 RPM
1— 300 HP G. E. 60 cy. 2200 V. 600 RPM
1— 300 HP West. 60 cy. 2300 V. 900 RPM
1— 200 HP West. 60 cy. 440 V. 1800 RPM
3— 150 HP West. 60 cy. 2300 V. 450 RPM
1— 100 HP G. E. 2300 V. 240 RPM (Super)

INDUCTION MOTORS

1—8000/1000 HP Cr. Wh. S/R 2200 V. FL 895/448 RPM
1—1200 HP Allis Chalmers S/R 2200 V. 440 RPM
1—1000 HP West. S/R 2200 V. 360 RPM
1— 300 HP West. S/R 2200 V. 1800 RPM
1— 200 HP G. E. S/C 2300 V. 1800 RPM
1— 200 HP G.E. S/R 2200 V. 435 RPM
2— 150 HP Al. Ch. 2300 V. 1800 RPM. New.
1— 150 HP Cr. Wh. 440 V. 1800 RPM. New.
2— 150 HP Burke S/C 440 V. 1800 RPM. New.
4— 125 HP Al. Ch. S/C 440 V. 435 RPM
1— 100 HP Louis Allis S/C 220/440 V. 1800 RPM
1— 60 HP West. S/C 2300 V. 1200 RPM

MOTOR GENERATOR SETS

1—1500 KW Allis Chal. 600 V. DC, 60 cy.
1— 500 KW Cr. Wh. 600 V. DC, 60 cy.
1— 400 KW Cr. Wh. 275 V. DC. 60 cy.
1— 400 KW Allis Chal. 275 V. DC. 25 cy.
2— 300 KW Allis Chal. 275 V. DC. 25 cy.
1— 300 KW West., 250 V. DC, 60 cy.
1— 250 KW Allis Chal., 275 V. DC. 25 cy.
1— 200 KW G. E. 2200 V., DC, 60 cy.
1— 200 KW West. 250 V. 3 W. 60 cy.
1— 75 KW West. 125 V. DC, 60 cy.
1— 50 KW West. 125 V. DC. 60 cy.

ROTARIES—60 Cy.

1—2000 KW Allis Chalmers 600 V.
1—1000 KW Allis Chalmers 600 V.
1—1000 KW Westinghouse 240 V.
1— 750 KW Westinghouse 275 V.
1— 750 KW General Electric 600 V.
1— 500 KW General Electric 275 V.
2— 500 KW Westinghouse 600 V.
1— 300 KW Westinghouse 600 V.
2— 300 KW Westinghouse 250 V.

FREQUENCY CHANGERS

1—2150 KVA G. E. 25/62½ cy. 750 RPM
1—1875 KVA G. E. 25/60 cy. 300 RPM
1—1200 KVA G. E. 25/60 cy. 300 RPM
2—1000 KVA G. E. 25/60 cy. 300 RPM
1— 938 KVA West. 25/62½ cy. 750 RPM
1— 600 KVA G. E. 60/25 cy. 300 RPM

TRANSFORMERS—60 Cy.

3—40000 KVA Al Ch. 63500/110000 Y—13800 V.
8— 833 KVA Al. Ch. 33000-4800 V.
3— 3750 KVA West. 26400/13200—2400 V.
1— 1000 KVA G. E. 24000-11500 V. 3 ph.
2— 1000 KVA G. E. 23000-11500—575 V.
3— 750 KVA West. 22000-2300/4600 V.
2—10000 KVA Pittsburgh 13200-4600 V. 3 ph.
3— 500 KVA West. 13200-2300/4600 V.
2— 1000 KVA G. E. 11500/23000—575 V.
1— 8000 KVA Penn. 6400/13200—2400 V. 3 ph.
1— 1500 KVA West. Auto 4150-2300 V. 3 ph.
1— 2500 KVA Penn. 4150—480 V.
3— 167 KVA G. E. 2400/4160Y—120/240 V.
3— 667 KVA G. E. 2300—575 V.
1— 400 KVA G. E. 2300—550 V. 3 ph.
1— 100 KVA G. E. 2300—575 V.
3— 20 KVA West. 2200—575/287½ V.

OIL CIRCUIT BREAKERS

1—	400 A. 37 KV West G11	Outdoor
2—	400 A. 25 KV G. E. FKO136	Outdoor
2—	1000 A. 23 KV Kelman CB76	Outdoor
6—	600 A. 15 KV G. E. FK255	Indoor
4—	600 A. 15 KV G. E. FHKO139-24BS	Outdoor
1—	600 A. 15 KV G. E. FK037	Pole type
2—	400 A. 15 KV G. E. FHKO136	Outdoor

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1—3500 KW 480 V Cond.
2—2500 KW 440 V Cond.
1—3000 KW 600 V Cond.
1—2000 KW 600 V Cond.
1—2000 KW 480 V. N. C.
2—1500 KW 2300 V Cond.
1—1250 KW 2300 V Cond.
2—1000 KW 440 V Extrac.
1—1000 KW 2300 V Cond.
2— 500 KW 600 V Cond.
1— 500 KW 240 V Cond.
2— 125 KW 220/440 V N. C.
1— 250 KW 2300 V N. D.
1— 125 KW 600 V Extrac.
1— 50 KW 220 V AC. N.C.

ENGINE GENERATORS

1—375 KW 2300 V Uniflow
1—168 KW 600 V.
2—280 KW 480 V.
1—250 KW 480 V.
1—150 KW 180 V.
1—125 KW 125/250 V.D.C. Uniflow

TURBINES ONLY

1—375 H.P. with gears
1—210 H.P. Terry 250#

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2—30,000# 425 PSI
1—1030 HP 225#
1— 500 HP 400#
4— 500 HP 200#
2— 480 HP 225#
2— 400 HP 180#
1— 250 HP 180#
2— 175 HP 200#
1— 150 HP 150#
1—100 HP 133# Scotch
1— 75 HP 150# New
1— 50 HP 200#

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1—6000 CFM 50# Motor
1—2700 CFM 100# Motor
1—1200 CFM 100# Belted
1— 700 CFM 100# Belted
1—5000 CFM 10# Rotary Type 440 V Syn. Motor
1—6000 CFM 5.1# New

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3—200 KVA 600/220/110

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Brand new. Built by Allis Chalmers to rigid specifications of the U. S. Navy

K.V.A. output 1,250 R.P.M. 3600
K.W. output 1. Cont. Duty Ph. Single
P.F. 80 Cycles 60
Volts input 115 D.C. Volts output 120 A.C.
Amps input 14 Amps output 10.4
Length 26"; width 12⅞"; height 13"

Compound accumulative A.C. and D.C. fields. Centrifugal starter. Splashproof covered. Frequency adjustable to load, plus or minus five cycles.

PRICE $87.50

Identical Machine, but 230 volts D. C. input, $125.00

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100 KW DC GENERATORS
240-120 Volts 1200 R.P.M.
Model GBD-8 Driven by Superior
Diesel 150 HP. Electric Starting, Aux. Available

MOTORS

GE Synchronous 6000 H.P. A.C. 3 Phase 2700 Volts 984 Amps. 93 - ⅓ Cycle 400 R.P.M. Type T.S.M.-28 Note: These motors can be run on 60 cyc., 1700 volts and will produce 3800 H.P. at 257 R.P.M. Can also be used as generators. Switchboards available.

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1 H.P. to 200 H.P.

DC MOTORS
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Foster-Wheeler
Capacity Steam Per hr. 60000#
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Babcock & Wilcox
Capacity Steam Per hr. 22500#
Working Pressure 250#

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Capacity Steam Per hr. 65000#
Working Pressure 250#

Cleaver Brooks
Package type with Fixed Pump
100# Designed Pressure.

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Carrier Corp., Two cyl. Compressor, Crocker Wheel. Motor Dr. Compressor RPM 600. Motor RPM 1750. Discharge pressure 100#. Capacity 215 Tons.

WINDLASSES
20 H.P. 17 KW
230 Volts D.C. 1150 RPM.
Gear Motor

WINCHES (ELEVATOR)
20 H.P. 17.6 KW 230 Volts D.C.
30 RPM. Gear Motor

WINCHES (TOWING)
50 H.P. 43 KW 230 Volts D.C.
525 RPM.

WINCHES (BOAT)
25 H.P. 230 Volts D.C.
90 Amps. 1750 RPM.

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Control Panel
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Motor Generator 8.5 HP 5 KW

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Rotary Pumps Turbine Drive
Centrifugal Pumps Turbine Drive
Centrifugal Pumps Motor Dr (Vertical & Horizontal)
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MOTORS
3 PHASE—25 CYCLE—220 440 VOLTS

H.P.	Make	Type	Frame	RPM
5	West.	CS		750
5	West.	CS		750
5	West.	CS		750
5	West.	CS	453	750
5	West.	CS	453	750
5	G.E.	KT	948	1430
5	G.E.	KT	948	1430
5	G.E.	KT	948	1430
10	G.E.	KT	312	750
15	G.E.	I Form K		750
15	West.	CS	573	750
20	West.	CS		730
25	West.	CS		730
40	G.E.	I Form K		750
75	G.E.	I Form K		500
100	G.E.	I Form K		750
100	West. (2200 v.)	CS	871/526	460
125	West (S.R.)	CW		480
150	G.E.	I Form K		365
150	G.E. (2200 v.)	I Form K		750
150	G.E. (2200 v.)	I Form K		750
150	Allis Ch.	Slip Ring		720
150	G.E. (2200 v.)	KT b.b.	557Y	1470
200	West. (2200 v.)	CS	1013	480
200	G.E. (2200 v.)	I Form K		485
200	G.E. (S.R.)	I Form M		480
200	West. (S.R.)	CW	1011	480

2300 VOLT PRIMARY CONTACTORS

1—225 HP. Square D Magnetic Controlled, 3/60/2200 Volts.

1—200 Amp Schweitzer-Conrad Load Break, 3 Pole Fused, 3/60/2200 Volts.

FREQUENCY CHANGERS

All Sizes in Stock. 60 cycle to 90 cycle. 100 cycle, 120 cycle, 180 cycle and any other high cycle if desired.

25 CYCLE TRANSFORMERS

3—667 KVA General Elect. Type H, Form VDDJ, Single Phase 25 Cycle 13,200 Volts Primary—with Taps—240/480 Volts Secondary.

25 CYCLE MOTORS

1—1270 HP. Gen. Elect. Synchronous Motor Type A.T.I. 3/25/2200 Volts 150 RPM.

1—1900 HP. Gen. Elect. Synchronous Motor Type A.T.I. 3/25/2200 Volts 150 RPM.

MOTOR GENERATOR SETS

2—350 KW General Electric Sets 250 Volts D.C. driven by 500 HP 3 Phase 25 Cycle motors.

1—30 KW Gen. Elec. Generator, Type DLC-203, 125 v. direct connected to 40 HP Gen. Elec. Motor, 3/440, 60/720 RPM with panel board.

ROTARY CONVERTER

1—2000 KW Westinghouse Booster type Rotary Converter 230 Volt D.C.—3 to 6 Phase, 25 Cycle, 4600 Volt Transformer.

NEW MOTORS

300 New Gen. Elect. & Westinghouse Motors in stock from 1 to 100 H.P.

MOTORS

1—75 HP. Gen. Elect. Type I Form K. 3/60/440/720 RPM.

1—75 HP. Fynn-Weischel Synchronous 3/60/440/1200 RPM.

1—75 Gen. Elec. Slipring Type I Form M., 3/60/440/450 RPM.

1—100 HP. Gen. Elect. Type K (New Motor) 3/60/440/1800 RPM.

1—100 HP. Westinghouse Slipring Type CW, 3/60/440/435 RPM.

1—100 HP. Gen. Elect. Slipring Type I Form M, 3/60/440/2200/720 RPM.

1—100 HP. Westinghouse Motor Type CS-867A, 3/60/440/835 RPM.

1—100 HP. Westinghouse Slipring Type CW 3/60/440/1200 RPM.

1—170 HP. Crocker Wheeler Slipring 3/60/440/600 RPM.

1—200 HP. Gen. Elect. Slipring Type I Form M, 3/25/440/500 RPM.

1—500 HP. Allis Chalmers Slipring 3/60/2300/514 RPM.

1—500 HP. Gen. Elect. Type I Form K, 3/25/440/485 RPM.

1—600 HP. Westinghouse Motor Type CS, 3/25/550/490 RPM.

1—600 HP. Gen. Elect. Slipring Type MT, 3/25/550/490 RPM.

1—1500 HP. Allis Chalmers Synchronous, 3/60/2300/164 RPM.

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SQUIRREL CAGE MOTORS
3 PHASE 60 CYCLE

Qu.	H.P.	Make	Type	Volts	R.P.M.
7	10	Whse.	C.S.	440	575
1	10	G.E.	KT-753	440	850
1	10	G.E.	K-324	208	1750
1	10	Al. Ch.	X	220	1750
1	20	G.E.	I.K.	220	565
1	20	Whse.	C.S.	550	1750
1	25	G.E.	F.T.R.	220	575
2	25	G.E.	K.T.	220	900
1	25	Whse.	C.S.	220	1160
1	30	Whse.	C.S.	550	900
1	35	G.E.	I.K.	2200	1200
1	40	F.M.	H	220	860
2	40	Al. Ch.	A.R.	440	860
2	40	F.M.	B	220	1150
1	40	G.E.	K.T.	220	1800
1	40	Whse.	CS-650	2200	1760
1	50	G.E.	I.K.	440	695
1	50	Whse.	C.S.	220	870
1	50	G.E.	K.T.	440	1160
1	50	Ideal	A.T.	440	1750
3	75	Al. Ch.	A.R.	220	1750
2	100	G.E.	I.K.	2300	695
5	100	F.M.	HS201C	440	900
4	125	Al. Ch.	A.R.	440	435
1	125	Whse.	CS-761	440	1750
3	125	Al. Ch.	A.R.	2200	1750
2	135	G.E.	KF542	440	1200
1	200	G.E.	I.K.	2300	490
1	200	Al. Ch.	A.R.	2200	3550
1	250	Whse.	C.S.	2200	1160

3—200 hp GE-KG 557Z 440/3/60 cy 1750 RPM—BB.—FC.—TE.

SYNCHRONOUS MOTORS
3 PHASE 60 CYCLE

Qu.	H.P.	Make	P.F.	Volts	R.P.M.
1	30	Whse.	.8	220	1800
2	50	G.E.	.8	2200	600
1	60	G.E.	.8	440	1200
1	100	G.E.	.8	440	900
1	100	Whse.	1.0	2200	1200
1	150	G.E.	.8	440	900
1	150	G.E.	1.0	2200	900
1	150	G.E.	.8	2200	1200
1	500	G.E.	.8	2200	720
1	885	G.E.	.8	6600	514

CAN FURNISH ABOVE WITH EXCITERS, REDUCED VOLTAGE MAGNETIC OR SEMI-MAGNETIC OR FULL VOLTAGE MAGNETIC CONTROLLERS.

SLIP RING MOTORS
CONSTANT DUTY
3-PHASE 60-CYCLE

Qu.	H.P.	Make	Type	Volts	R.P.M.
2	5	Al. Ch.	ARY	440	720
3	10	G.E.	I-M	220	1120
2	15	G.E.	I-M	220	1200
1	20	G.E.	MT-326	220	900
2	25	G.E.	MT-326	2200	850
4	25	G.E.	MT-526	440	900
2	25	Whse.	CW-481	440	1750
1	30	Al. Ch.	ARY	440	900
1	30	Whse.	CW	440	1160
1	40	Al. Ch.	ANY	2200	435
3	40	G.E.	MT-346	550	580
1	40	Whse.	CW-644	220	870
3*	40	G.E.	I-M	600	1170
1	50	Al. Ch.	ARY	2200	490
2	50	G.E.	MT-536	2200	1200
1	75	G.E.	MT-548	440	1200
1	75	Al. Ch.	ARY	440	1750
1	100	G.E.	MT-356	440	900
2	125	G.E.	MT-558	2200	900
1	150	Whse.	CW	2300	1200
1	200	C.W.	127AQ	440	590
1	200	G.E.	I-M	2200	580
1	250	Whse.	CW	2200	580
1	300	G.E.	MT-412	2200	360
1	300	G.E.	IM	2200	1200
1	300	Al. Ch.	ARY	2200	514
1	300	G.E.	IM	440	580
1	400	Whse.	CW-1108	2300	500
1**	1200	Whse.	CW	2300	590

*—40 cycle. **—Heavy duty mill type.

CAN SUPPLY THE ABOVE WITH PRIMARY CONTROL (OCB OR MAGNETIC) SECONDARY CONTROL (NON-REV. DRUM CONTROLLER OR FULL MAGNETIC) WITH STARTING DUTY OR VARIABLE SPEED REGISTERS.

TRANSFORMERS
OIL-COOLED

Qu.	K.V.A.	Make	Voltage	Ph.	Cy
3	25	G.E.	1100/ 2200/ 608	1	40
3*	37½	Whse.	460/ 230/ 230/115	1	60
2	50	Wag.	132000/11880/ 575/287	1	60
3	130	G.E.	19000/ 9500/ 550/2200	1	60
6	165/247	G.E.	38100/22000/11000/430/215	1	60
1	200	Whse.	3810/ 2300/ 440	3	60
3	200	G.E.	2400/4500-Y138/230/460	1	60

MOTOR GENERATOR SETS

1—9 KW. G.E. CD. 250-VDC., dir. con. 15-HP. G.E. Sq. Cg. Motor, 220/440-V., 3-Ph., 60-Cy., 1800-RPM.

4—25 KW. Whse. SK. 3-wire, 120240-VDC., 1200-RPM., dir. con. 40-HP. Sq. Cg. Motor, 220/440-V., 3-Ph., 60-Cy.

2—3-Unit Sets, (2) 25 KW. Whse. SK, 3-wire gen. 120/240-VDC., 1200-RPM., dir. con. 75 or 100-HP. Sq. Cg. or Syn. Motor, 220/440 and 2200-V., 3-Ph., 60-Cy.

1—50 KW. Louis-Allis, 124/240-VDC., dir. con. 75-HP. Sq. Cg. Motor, 220/440-V., 3-Ph., 60-Cy., 1200-RPM.

2—(NEW) G.E. 94 KW, 62½-VDC., Type CD generator, dir. con. 135-HP. Sq. Cg. Motor, 220/440 V., 3-Ph., 60-Cy., 1200-RPM., generator and motor B.B., splash-proof.

1—100 KW. Al. Chal. 125-VDC. generator, dir. con. 150-HP. syn. motor, 2300-V., 3-Ph., 60-Cy., 900-RPM.

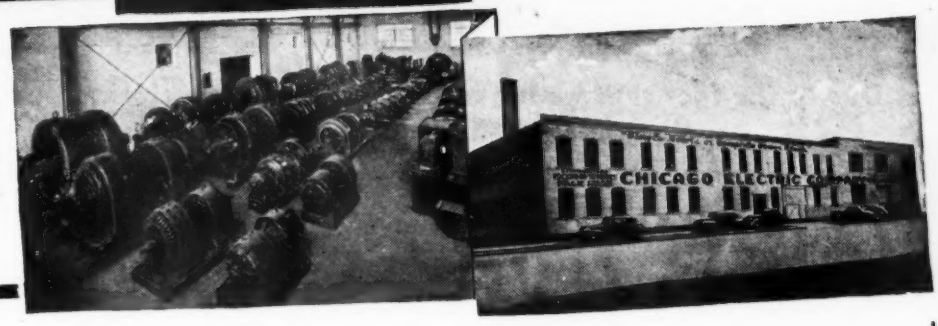
1—200 KW. G.E. 250 VDC., 1200 RPM., dir. con. 300 HP. syn. motor, 2300/3/60 cy.

T. B. MAC CABE COMPANY.

4312 CLARISSA STREET PHILADELPHIA, PENNA.

QUALITY POWER EQUIPMENT From CHICAGO ELECTRIC CO.

Rebuilders, Engineers, and Distributors of Fine Equipment *Since 1910.*



MOTOR GENERATOR SETS

KW	Make	AC	DC
1000	Gen. Elec.	4000	600
800	Wtghse.	13200	250
500	Gen. Elec.	4600	250
500	Gen. Elec.	13200	600
350	Gen. Elec.	440	250
150	Gen. Elec.	2300	275
90	Gen. Elec.	2300	110
75	Wtghse.	110	2200

SPECIAL

1—2500 KVA Westinghouse transformer, type OISC, 3 phase, 60 cycles, 2400 volts primary to 480 volts secondary, with 2 2½% taps above and below. Rebuilt, ready for immediate shipment.

BENCH GRINDERS

23—1/3 HP new "B-Line" bench grinders, 1 phase, 60 cycle, 110 volts, 3450 RPM, totally enclosed, ball bearing, complete with two 6"x¾" coarse and fine wheels, wheel guards, adjustable tool rests, cord and plug, switch mounted in grinder base.

SQUIRREL CAGE MOTORS

HP.	Make	Type	Volts	Speed
800	Wtghse.	CS	2200	706
500	Elliott		2300	720
500	Gen. Elec.	IK	440	1200
350	Lincoln		440	900
350	Gen. Elec.	I	440	575
300	Wtghse.	CS	440	400
250	Gen. Elec.	I	2200	900
250	Wtghse.	TEFC	440	1800
200	Wtghse.	CCL	440	1200
200	Wagner		440	1800
150	Gen. Elec.	TEFC	440	900
150	Gen. Elec.	K	440	1180
150	Gen. Elec.	K	2200	720

SLIPRING MOTORS

HP.	Make	Type	Volts	Speed
1000	Wtghse.	HR	2300	360
750	Wtghse.	CW	2300	440
600	Gen. Elec.	IL	6600	300
600	Gen. Elec.	M	440	1775
500	Lincoln	I	440	900
435	Gen. Elec.	I	4000	1180
400	Gen. Elec.		2200	450
400	Allis Chlrs.	ANY	4000	1180
350	Gen. Elec.	IM	440	720
300	Wtghse.	CW	440	600
300	Gen. Elec.	M	440	3365
250	Allis Chlrs.	ANY	440	505
250	Gen. Elec.	IP	440	450

SYNCHRONOUS MOTORS

HP.	Make	Type	Volts	Speed
2100	Gen. Elec.	ATI	4600	514
885	Gen. Elec.	ATI	6600, 11400	514
700	Wtghse.		440	900
600	Gen. Elec.	TS	2300	900
600	Wtghse.		2300	900
500	Gen. Elec.	TS	2300	450
450	Elec. Mach.	BRG	440	240
430	Gen. Elec.	ATI	2200	720
400	Gen. Elec.	TS	440	600
300	Ideal	Engine	2300	300
300	Gen. Elec.	TRC	440	240
300	Elec. Mtr.		440	240

D. C. MOTORS

HP.	Make	Type	Volts	Speed
430	Gen. Elec.	MPC	250	950
300	Gen. Elec.	MP	250	425
200	Wtghse.	SK	230	1150
100	Gen. Elec.	RC	220	2500
60	Gen. Elec.	CD	550	1000
45	Wtghse.	S	250	650
40	Crocker Whlr.	CCM	230	575
40	Gen. Elec.	E	220	620
35	Crocker Whlr.	CM	220	840
35	N. Western		230	1275
30	Crocker Whlr.	CCM	220	450
30	Allis Chlrs.	Bullock	230	575
27½	Gen. Elec.	CL	220	700

GEARHEAD MOTORS

HP.	Make	Type	Volts	Speed
5	Gen. Elec.	K	220/440	98.9
3	Sterling	KFA	220/440	350
3	Gen. Elec.	KT	440	488
2	Sterling	KFA	220/440	230
2	Sterling	KFB	220/440	59
2	Gen. Elec.	K	220/440	100
2	U. S. Elec.	GH	220 440	230
1½	Gen. Elec.	KJ	220/440	230
1½	Gen. Elec.	K	220/440	37
1½	Gen. Elec.	K	220/440	98.6

CHICAGO ELECTRIC CO.

1320 West Cermack Road — **Chicago 8, Ill. Can. 2900**

SYNCH. CONVERTERS

200 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM. 6 PH. 60 CY. SWITCH GEAR AND TRANSFORMERS.

MOTOR GENERATORS

500 KW G.E. SYN. 600 V. 2200/4000 A.C. 1200 RPM. 3 PH. 60 CY. COMPLETE MANUAL SWITCHGEAR.

400 KW WEST SYN 600 V. 2200 A.C. 70 RPM. 3 PH. 60 CY. COMPLETE MANUAL SWITCHGEAR.

300 KW RIDGWAY SYN. 250 V. 2200 A.C. 1200 RPM. 3 PH. 60 CY. COMPLETE MANUAL SWITCHGEAR.

200 KW RIDGWAY SYN. 250 V 2200 A.C. 900 RPM. 3 PH. 60 CY. COMPLETE MANUAL SWITCHGEAR.

Each unit listed above is owned by us and is available now for immediate purchase

WALLACE E. KIRK COMPANY
Incorporated
502 Grant Building, Pittsburgh, Pa.

BOILERS

2—404 H.P. Springfield, oil burners 170#
1—550 H.P. W.W. sectional header 200#
4—300 H.P. Casey-Hedges, oil, 165#
2—25,000# Stirling's, pulverizers, 425#

Other sizes and types

H. P. BREARLEY
3423-91st. Street Jackson Heights, N. Y.

POWER PLANT SPECIALISTS

SINCE 1912

PARTIAL LISTINGS

SIX—400 H. P.—225 LB. STEEL ENCASED CROSS DRUM TYPE—WATER TUBE BOILERS—OIL FIRED.

ONE—400 H. P.—300 LB. WATER TUBE, CROSS DRUM TYPE BOILERS, ASME.

ALSO STEAM TURBINES, DIESEL SETS, MOTORS AND MOTOR GENERATORS, SWITCHES, ETC.

NOTE OUR NEW LOCATION

HOWE BROTHERS

342 MADISON AVENUE — NEW YORK 17, N. Y.

Tele. Nos. Mur. 2-8562-8563-8564

INVENTORY CLEARANCE

Due to the fact that we are overstocked, we are closing out the following totally enclosed, fan cooled, ball bearing motors, at reduced prices.

***The Christmas spirit is with us*—We are practically giving these motors away.**

Qty.	HP	RPM	Frame	Qty.	HP	RPM	Frame
1	2	900	254	32	5	1800	254
90	2	1200	225	5	5	3600	225
2	2	1800	224	1	7½	900	326
6	2	3600	224	24	7½	1200	324
3	3	900	284	36	7½	1800	284
99	3	1200	254	10	7½	3600	254
29	3	1800	225	1	10	900	365
12	3	3600	224	2	10	1200	326
2	5	900	324	12	10	1800	324
22	5	1200	284				

The above motors are all Nema frame, 3 phase, 60 cycle, 220/440 volt in Standard Makes such as General Electric, Westinghouse, Howell, Wagner, Louis-Allis, Fairbanks-Morse, Reliance and Delco.

START THE NEW YEAR (RIGHT WRITE) to us for quotations on any electrical equipment such as motor generator sets, slip ring motors, synchronous motors, gear head motors, transformers, and all types of control equipment.

J. E. BERGER CORPORATION

4550 MAYBURY GRAND AVENUE, DETROIT 8, MICHIGAN

TELEPHONE: TYLER 8-4400 **WETERN UNION: WUX**

AVAILABLE from STOCK!

A Few Typical Items in Our Current Inventory

SQUIRREL CAGE MOTORS

(NEMA Frame)

220 440 volts, 3 ph., 60 cycle

Qu	HP	RPM	Make	Type
10	1	1800	A.C.	BB. DP—New
7	1	1800	L.A.	TEXP New
10	2	1800	Al. Ch.	BB. DP—New
10	3	1200	Al. Ch.	OBB
10	3	1200	Al. Ch.	XP CL1 Gp.D New
35	3	1800	Al. Ch.	BB. DP—New
10	5	1200	Al. Ch.	OBB
30	5	1800	A-C.	BB. DP—New
2	7½	1200	Al. Ch.	OBB
1	7½	1200	C-W	TEXP
10	7½	1800	L. Allis	OGX—New
2	10	530	Wagner	HS-HT—R&G
1	10	900	G.E.	SB-DP—New
1	10	1750	Al. Ch.	TEFC
1	10	1800	Al. Ch.	OBB—New
1	10	1800	Al. Ch.	TEFC—New
7	10	1800	Al. Ch.	OBB—New
2	10	3600	Al. Ch.	OBB—New
2	10	3600	G.E.	BB. DP—R&G
3	15	1200	G.E.	BB. DP—New
1	15	1200	G.E.	HT—New
1	15	3600	G.E.	SB. DP—New
3	20	1200	Al. Ch.	OBB—New
1	20	1750	Al. Ch.	550v.—OBB
1	50	1200	Al. Ch.	OBB—New
2	50	1200	Al. Ch.	OBB—New
1	50	1800	Al. Ch.	OBB—New
1	125	1800	Al. Ch.	OSB—New

D. C. MOTORS, 230 VOLTS ADJUSTABLE SPEED, RECONDITIONED AND GUARANTEED

(Except New Where Shown)

Qu	HP	RPM	Make	Type
3	3/5	1150/2825	Reliance	14-T
2	3/5	500/1500	Wstg.	SK-90
1	3/5	600/1800	Wstg.	SK-50
1	3/5	300/900	Elec. Dyn.	Frame 5-S
1	5/7½	500/2000	L. A.	Frame 851
1	7½/10	250/1000	Wstg.	SK-91
1	7½/10	600/1800	Wstg.	SK-63A
2	10/15	300/1200	G.E.	RLC-201
2	10/15	500/1500	Reliance	78-TF
3	10/15	400/1200	G.E.	CD-95
3	10/15	575/2300	G.E.	CD-85
3	10/15	400/1350	Marble-Card	Shunt
1	15/20	400/1600	C-W	TEFC
1	15/20	400/1600	Reliance	115-V.
2	15/20	500/1800	G.E.	RF-11
1	15/20	550/1650	G.E.	CD-103
5	20/25	400/1200	G.E.	CD113, RF13
7	20/25	600/2000	G.E.	CD-105
3	40/50	250/1500	G.E.	CD-1441
1	40/50	350/1050	Wstg.	SK-141
1	50/60	300/900	Elec. Dyn.	30-S

Plus large stock of excellent constant-speed motors.

SPECIALS

13—7½ HP, 600 RPM, 230 v. D.C. Westinghouse SK-93 motors, TEFC, double-end shaft, compound wound.

5—Reliance 40-VS drives, with 40/50 H.P. D.C. motors and complete A.C.-D.C. controls 220/440-3 60

18—3 KW M-G Sets, 250 volts D.C. 220/440 volts A.C., dripp-proof flat compounded.

20—New Harnishchfeger Electric Hoists, 500 to 2000 lbs. capacity, 220/440/550 volts.

2—New Cutler-Hammer Bulletin 9586, Size 6, Across-the-Line Starters, 400 H.P., 440 volts, with O/L relay.

We can furnish any A.C. or D.C. control to your specifications up to 1000 H.P., 4160 volts.

Also Many Other New and Reconditioned A.C., D.C. Motors, 1/6 H.P. to 150 H.P.

THE A-C SUPPLY CO.

Plant & Office ***P.O. Box 991*** **Telephone (Akron)**

Cuyahoga Falls, O. **AKRON, OHIO** **WAlbridge 1174**

PUMPS, MOTORS & AIR COMPRESSOR

Large Stock at All Times of

AURORA CENTRIFUGALS
BARNES CENTRIFUGALS
AMERICAN ROTARY
BLACKMER ROTARY

Rebuilt Pumps in Centrifugals

STEAM & HIGH PRESSURE HYDRAULIC

C & S MACHINERY CO.

715 Howard Street St. Louis 6, Mo.

Garfield 4290

FOR SALE

1250 HP Nordberg diesel 5 cyl. 2 cyc. 850 KW 3 phase, 60 cyc., 2300 volts generator.

750 KW GE condensing turbine 3 stage, 3600 RPM 3 phase, 60 cyc., 2300 volt. Surface condenser.

25 KW International UD-14 portable diesel generator set, 220 volts. Like new.

MISSISSIPPI VALLEY EQUIPMENT CO.

507 Locust St. St. Louis 1, Mo.

REBUILT POWER EQUIPMENT—READY TO SHIP

M.G. SETS
250 V. D.C.
(Motors 220/440 or 2200 V. 3 ph. 60 cy.)

No.	KW	Make	Speed
½	15	West.	1150
1	20	West.	900
2	40	West.	850
5	50	West.	1200
2	75	Star	1200
2	75	G.E.	600
4	100	Star	1200
1	150	G.E.	1200

Can furnish M.G. Sets at 125 V.D.C. from 5 kw. up to 100 kw. for immediate shipment from stock.

DYNAMOMETER
"Hi-Eff" hydraulic size 35#, model 588, 3100 rpm., Taylor Mfg. Co.

FREQUENCY CHANGERS
3—25 kw., 220/440 v. 3 ph. 180 cy., G.E. dir. con. to 25 HP, 1800 rpm., 220/440 v. 3 ph. 60 cy. motors.

COMPRESSORS
1—315 cu. ft. 100 lb. pres. Ingersoll-Rand, Models 315 and 315A portable Air Compressors with 105 HP Waukesha Oil Engines, complete with accessories.
10—240 CFM Westinghouse 150# pres. 3 cyl., vert., dir. con. 50 HP. A.C. Slip Ring Motors.

INDUSTRIAL TRUCKS
5—Automobile type LO-5 Low Lift Electric Trucks capacity 5 ton platform type.
5—New 4 ton Yale & Towne Model Y8W Multi-stroke Hand Lift Platform.

INDUCTION HEATING CONVERTER
New Van Norman, type indoor, floor, hi-freq. 32 kw. 220 v. 1 ph., 60 cy. 150 A. enclosed type.

FIRE PUMPS
3—1000 GPM Worthington Cent. 1 stage, 6½" suc. 5" dis. 150# pres. dir. con. 133 HP., 875/1750 rpm., 230 v. DC Motors and control. (Can furnish A.C. Motors if desired.)

SPECIAL * A.C. Motors 3 ph. 60 cy.
1—1400 HP., West. SYN 2300/4000/440/220 v. 1200 rpm.
1—500 HP. Elec. Machy. Syn. 4000/2200/440/220 V. 120 rpm.
1—125 HP. G.E. type K, 220/440 v. 440 rpm.
11— 75 HP. Commonwealth 440 v. 1165 rpm., with Stearns Magnetic Brakes.
1—New 75 HP. West. type CS, 220/440 v. 3600 rpm.
60—New ½ HP., Diehl 220/440 v. 1725 rpm., tot. enc. BB.

DEGREASER
Blakeslee, Liquid fully conveyorized, immersion loading and unloading at opposite ends, 13' long 5'3" wide, 10'8" high with ¾ HP. A.C. motor. Conveyor speed 9 rpm., dual vapor control, gage glasses, thermometers, necessary piping and fittings, double strand chain conveyor with cross rods. 25"x20"x3" deep baskets, ¾" Sacro TR-40-3 Water Control, 1¼" Sacro SF, 11 Vapor control, storage Tanks, #3 Still, Trans. pump and motors.

DUST COLLECTING UNITS
5—NEW portable, self contained ¼ HP. A.C. Motors, overall Diam. 25"x14½"x23" single inlet, single outlet Fried Air Kool Co.

WINCHES
240—Winch assembly portable engine hoists, swivel hook, 4¾" l, with 1½" opening and 30' of ¼" cable. Hand cranked, double reduction gear with drum 5¾" w. can be used with A.C. or D.C. Motors.

25 cycle MOTORS
2—300 HP. G.E. Slip Ring 2200 v. 3 ph. 375 rp. with control.

FANS or BLOWERS
4—NEW 12000 CFM, Amer. Blower dir. con. 12½ HP. 2 speed A.C. Motors with starters.

A.C. GENERATORS, 3 ph., 60 cy.

KW	Make	RPM	Voltage
1250	West.	1200	220/440/2300/4000
450	Elec. Machy.	120	220/440/2300/4000

SLIP RING MOTORS 3-ph. 60 cy.
2—600 HP. G.E. 2200 v., 900 rpm., MT.
2—500 HP. G.E. 2200 v., 900 rpm., MT.
2—400 HP. G.E. 2200 v., 900 rpm., MT.
1—250 HP. West. 220/440 v., 1800 rpm., CW.
1—150 HP. G.E. 220/440/550 1800 MT.
1— 75 HP. G.E. 220/440/550 600 I-M.

WELDING AND PLATING SETS
1—Chandeysson 50 KW., 40 V. D.C. 600 rpm., 75 HP. Synchronous Motor 220/440 v. 3 ph. 60 cy., with exciter 100% P.F.
1—Thompson Shell Welder including West. control, 6 electronic tubes, ½ HP. A.C. Motor.
1—Federal special seam welder 200 kva., 220/440 v. 60 cy. 5 DC max. sec. amps. 34000 at ¼ x 33 throat, sec. volts 5.1 10.2 max. air pres. 90 min. water inlet pres. 65# 70 deg. F max.
1—Federal seam welder 150 kva., 220/440 v. 60 cy., .5 DC max. sec. amps. X30,000 at 4 BY-28 throat sec. volts 4-8 max. air pres. 90 deg. min. water inlet pres. 50 lbs. at 70 deg. F 1 HP. AC. Motor.

POWER PLANTS
5—NEW 1½ kw. Homelite portable 115 v. 1 ph. 60 cy. 1 cyl. air cooled 2 cycle gas or gasoline.
2—10 kw. 120/v. Star Generators dir. con. to Hercules DIESEL, 250.
1—25 kw. 120/208 v. 3 ph. 60 cy. 80% P.F. West. Gen. dir. con. to Le Roi Gasoline Engine.
2—30 kw. 125v. G.E. Generators dir. con. Buda DIESEL.
1—35 kva. Ridgway 220/3/60 dir. Con. Ridgway STEAM engine.
1—125 kva. West 240/480 v. 3 ph. 60 cy. West. dir. con. Erie Ball STEAM Engine.

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

NEW AC MOTORS

3/60/220/440 VOLTS

Quan.	HP	Speed	Remarks	Quan.	HP	Speed	Remarks
3	¼	1200	220 V.-T.F.	1	2	1800	X.P.
1	½	1200	T.E.	1	2	1800	Open
1	½	1800	T.E.N.V.	1	2	3600	T.E.
3	1	1200	T.E.	2	2	3600	T.E.F.C.
1	1	1200	X.P.	1	3	1200	X.P.
1	1	1800	220 V.-X.P.	1	3	1200	208 V.-X.P.
2	1½	1200	T.E.	2	3	1800	T.E.F.C.
1	1½	1200	T.E. w/Brake	3	3	3600	T.E.F.C.
1	1½	1800	T.E.	1	5	1200	X.P.
1	1½	1800	X.P.	6	5	1200	T.E.F.C.
2	1½	3600	T.E.	1	7½	1200	T.E.F.C.
6	2	1200	T.E.F.C.	1	7½	1200	X.P.

1/60/110/220 VOLTS

7	1	1200	T.E.	1	2	1200	Open
3	1½	1800	X.P.	1	3	1800	Open

NEW GEAR MOTORS

3/60/220/440 VOLTS

Quan.	HP	Output RPM	Remarks	Quan.	HP	Output RPM	Remarks
1	¼	96	440 V.-Open	1	½	290	Open
1	¼	72	Open	1	1	37	Open
			(1/60/110 Volts)	1	1	45	Open
1	½	72	440 V.-Open	1	2	98.9	Open
1	1½	86.2	Open				

MOTORS
1—125 H.P. West. Squirrel Cage, 3/60/2200 volt, 1800 RPM and Starter.
1—20 H.P. General Electric Induction Motor, 3/60/220 v., 1160 RPM.
2—Vertical Gear Head Motors, Crocker Wheeler, TEFC 10 H.P., 220/440 Volt, 60 cycles, 3 phase, 1745 RPM. Philadelphia Gear, output 425 RPM.
1—10 H.P. Sterling Type KRE enclosed Speed-trol motor 3/60/220/440 volt, 1350/900 RPM.

AIR COMPRESSOR
1—Ingersoll-Rand Compressor Type 40. 7" & 6¼" x 5" delivering 156 CFM at 100# with 40 H.P. Gen. Elec. TEFC motor, 3-60-220-440 volt, 900 RPM, Receiver and Control.

SPEED REDUCERS
4—Philadelphia Worm Gear size 00 type AT 1.65 H.P., 1750 RPM, 5-1/6 to 1 ratio.
1—Cleveland Worm Gear 100 AH, series 25, 12 H.P., 1140 RPM, 5¼ to 1 ratio.

Heat and Power Co., inc.

70 PINE STREET | DIGBY 8-0373 | NEW YORK 5, N. Y.

SLIP RING MOTORS
3-PH., 60 Cy.

HP	Volts	Make	Speed
200	2200/440	G.E.	600
200	440/220	G.E.	720
125	440/220	G.E.	600
150	440/220	Whse.	1200
125	440/220	G.E. (Hoist)	900
100	440/220	G.E.	720
100	440/220	G.E. (MTC)	900
100	2200/440	G.E.	600
80	440/220	G.E. (MTC)	900
75	2200/550	G.E.	900
60	440/220	G.E.	1200
60	440/220	Cr. Wh.	720
50	440/220	G.E.	900
40	440/220	G.E.	720

SYNCHRONOUS MOTORS
3-PH., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	2200/440	G.E.	ATI	600
250	440/220	Whse.	HR	277
240	2200/550	G.E.	ATI	900
240	440/220	G.E.	ATI	720
200	4150/2300	Whse.	G	1800
200	2200	G.E.	ATI	514
150	4150/2300	G	G	1800
150	440/220	G.E.	ATI	900
150	2200/440	G.E.	TS	600
125	2300	G.E.	TS	327
110	440/220	G.E.	TS	1800
110	440/220	G.E.	TS	257
100	440/220	G.E.	TS	900
100	440/220/25 cy	G.E.	TS	375
100	440/220	Whse.	G	1800
75	2200/440	Whse.	G	600
75	440/220	G.E.	TS	900

AIR COMPRESSOR UNIT
1—13" and 8" by 10" Worthington FEATHER-VALVE, 285 rpm, 110 lbs. ga., motor-driven, complete

CIRCUIT BREAKERS
1—2000 amp., ITE—3 pole—600 v., air circuit breaker
1—New 2500 amp., 600 v., type DA 75, 3 pole, Whse. air circuit breaker

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
600	2300/440	G.E.	KT	1200
500	440/220	G.E.	IK	900
400	550	G.E.	IK	720
300	2200/440	Whse.	CS	600
300	440/220	G.E.	KT	1800
200	2200/550	Cr. Wh.	SC	900
200	2200/440	G.E.	KT	1200
200	440/220	G.E.	IK	600
200	440	Whse.	CS	900
150	440/220	Howell	B. Brg.	1800
125	440	G.E.	KT	600
100	440/220	G.E.	KT	450
100	440/550	G.E.	KT	400
100	440	Whse.	CS	1800
75	440	G.E.	KT	360
75	550/220	G.E.	KT	1200
75	440	G.E.	KT	400

TURBO-GENERATOR
Generator, 125 kva, 1200 rpm, 440/220 v., Whse., dir. conn. by reduction gear to Turbine, 100 kw, 7380 rpm. non-condensing, 150/200 lbs. ga. pr., complete with dir. conn. exciter and switchboard; practically new condition, never used.

A. C. GENERATORS
1—320 kva., 600 rpm., 440/220 v., G.E.
1—300 kva., 600 rpm., 2200/440 v., G.E.
1—225 kva., 900 rpm., 2200/550 v., G.E.
1—225 kva., 720 rpm., 440/220 v., G.E.
1—190 kva., 514 rpm., 220/440 v., G.E.
1—150 kva., 900 rpm., 440/220 v., G.E.
1—100 kva., 327 rpm., 2300 v., G.E.
1— 98 kva., 1800 rpm., 440/220 v., G.E.
2— 75 kva., 1800 rpm., 440/220 v., Whse.
2— 75 kva., 1200 rpm., 440/220 v., G.E.
2— 30 kw., 1200 rpm., 440/220 v., G.E.

MOTOR GENERATOR SETS
1—125 kw., 250 v., 1200 R. Cr. Wh. conn to 200 hp. 2200/440 v., 3 ph., Sq. C. motor.
1—100 kw., 125 v., 1200 rpm. Whse., conn. to 150 hp. 440/220 v., 3 ph. syn. motor.
1—75 kw., 250 v., 1200 rpm. Whse., conn. to 112 hp. 440/220 v., sq. cage motor.
1—60 kw., 125 v., 1200 rpm. Whse., conn. to 75 hp. 440/220 v., 60 cy., syn. motor.
1—25 kw., 440/220 v., 1800 rpm. G.E. alternator conn. to 40 hp. 230 v., DC motor.

TRANSFORMERS
60 Cycle
1—1000 kva. Al. Chal., 2400-120/240/208 volts, 3 phase. NEW.
1—400 Kva. G.E. 2300-230/115 v.
3—200 kva. Al. Chal. 2400-120/240 volts. NEW.
1—150 kva. Whse. SK. 13200-125/215 v. 3 ph.
3—150 kva., G.E., 33000-2400 v. NEW.
3—50 kva. Whse. 4600/2300-230/115
6—37½ kva. Whse. 440-115. DRY.
3—37½ kva., G.E., 4800-240/120 v. NEW.
3—25 kva. G.E., 2300-230/115. DRY.

STEPHEN HALL & CO.
HARRY J. RICE PRES.
458 SEVENTH ST. HOBOKEN, N. J.

MOTORS

2200V 60 CYC. 3 PH.

1— 50 H.P. G.E. KR 527, 1800 RPM.
1— 50 H.P. G.E. MT slipring, 695 RPM.
1— 60 H.P. Westinghouse CS SB 1800 RPM.
1—100 H.P. G.E. KT 1800 RPM.
1—100 H.P. G.E. I-K 1800 RPM.

220 or 440V.

1—7½ H.P. G.E. MT 760, 1800 RPM.
1—15 H.P. West. CW 900 RPM.
1—30 H.P. West. CI 638, 900 RPM.
1—30 H.P. West. CI 690 RPM.
1—30 H.P. West. CW 900 RPM.
1—35 H.P. G.E. ITC 5012 1200 RPM.
1—25 H.P. West. CI 652-D 690 RPM.
1—50 H.P. West. CW 690 RPM.
1—50 KW West. MG se. 25 V. 1500 RPM., compound wound, complete with charging panels.
3—5—7½—10 H.P. Westinghouse SK, 850 RPM., 230 V. reasonable.

Penn Electrical Engineering Co.
SCRANTON, PA.

CUT TO SKETCH ⅛ to 24"
METROPOLITAN
PLUMBING SUPPLY CO., INC.
INDUSTRIAL AND MARINE SUPPLIES
LARGE SURPLUS STOCK
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ARCHER & BALDWIN, INC.
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NEW STEEL TANKS IN STOCK
3-420,000 GAL. CAP. - 50-42,000 GAL. CAP.
DARIEN CORP., 60 E. 42nd St., New York 17, N. Y.

MILLERS
USED REBUILT

#0 Diamond Plain, 5" x 20" Table.
#2H Milwaukee Plain,
#2 Ohio Plain,
#34-56 Cincinnati Hydro Miller,
#5 Cincinnati Plain,
#2 Cincinnati Universal,
#2A Brown & Sharpe Universal,
#2 Cincinnati Vertical.

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148 N. 3d St. Phila. 6, Pa.

Self-Contained Boilers

Two (2) 250 HP Kewanee Hor. return tube, built 1941, Natl. Board Stamped, 125 lbs. pressure, with or without Riley Stokers. Immediate Delivery.

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AC SKINNER ENGINE SETS for sale
1—140 KW, 2-200 KW, 1-150 KW.
also BOILERS
1—250 HP. 160#, new 1941, complete
4—290 HP. Sterling, 165#, complete
COMPLETE PLANTS
STEPHEN A. DOUGLASS CO.
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DIESEL GENERATOR UNIT
1500 H.P.—1250 KVA
Nelseco — General Electric
Modern, Supercharged, Bosch Injection
3/60/2400, 300 RPM, All Accessories, Complete
Immediate Stock Delivery Rebuilt
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NEW ILG MARINE BLOWER FANS
24"—6250 C.F.M. 33"—10000 C.F.M.
38"—15000 C.F.M.
Axial Flow—Propeller Type Driven by 230 volt DC Motors.
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FOR SALE—STARTERS
ACROSS THE LINE AUTOMATIC
For synchronous motors 200 H.P. and 250 H.P. 3-60-4150
Automatic Magnetic Reversible. Reduced Voltage Starters—1—165 H.P. 440 Volt for Slip Ring motor
1—100 H.P. 250 Volt D.C.
GUYAN MACHINERY COMPANY
LOGAN, W. VA.

APPLICATION ENGINEERS
45 KW M.G. Set 2200 AC 250 DC
100 KW M.G. Set 220/440 AC 125/250 DC
285 KW 240 volt Chase Uniflow engine set
200 KW 480 volt Ridgway engine set
2500 KW 2300 volt G.E. Cond Turbine set
200 KW 1800 rpm 440 volt TEFC Motor
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BOILERS
DIESEL UNITS
GENERATORS

200 HP Worthington Diesel engine set, 12½x13¼ cylinder with 150 KW Ideal Electric Co. type SAM 187 KVA, 60 cy., 3 ph. alternator, type D 125V DC generator 300 RPM, 75 KW, 60 amp.

40 HP Fairbanks Morse diesel generator set, Model 36A 4¼ with circulating pump and tower cooler. Direct connected to 32DVA alternator, 3/60/240V. DC Generator 1 KW, 1200 RPM, 125V full load.

Engine Driven generator, Hooven, Owens, Renschler, Corliss steam engine 30"x48" direct connected to GE 600KW AC generator belted to GE 25 KW DC exciter, 125V, 200 Amp., 700 RPM.

Turbo generator set — Westinghouse bleeder type steam turbine, 3600 RPM direct connected to Westinghouse 1250 KW, AC generator, 1562KVA, 2400V, 60 cy., 2 ph., 3600RPM, GE 3 to 2 ph. auto transformer 1500 KVA, Westinghouse field rheostat, with Alberger size D low-level jet condenser, Wheeler turbo volute centrifugal pump and Fairbanks Morse 100 HP induction motor.

Boilers, 434 HP all steel Heine water tube boiler, long drum type, 304 HP Heine water tube boiler, 613 HP Heine V type water tube boiler.

Lou Cohen Machinery Co.
619 N. Second — St. Louis, Mo.

FOR SALE

200 KW General Motors Diesel engines, 8 cyl., Model 8-268A, 6½" x 7" stroke, direct conn. to: 200 KW Westinghouse Alternators, 3 phase, 60 cy., 440 V., including switchboard.

1800 HP Fairbanks-Morse, Model 38D 8⅛, 8⅛" bore x 10" stroke, 800 RPM, 10 cyl., air start solid injection, new 1943. Engine weight: 33,000 lbs. Complete with all auxiliaries.

Other sizes in stock, immediate shipment.

ALJOHN DIESEL CO., INC.
904 Pacific St. — Brooklyn 16, N. Y.
Sterling 3-6515

AIR COMPRESSORS

2—175 CFM Inger.-Rand 2 cyl. vert. 150 P.S.I. Type XIV, dir. con. to G.E. 50 HP DC motor, 230 V. 400 RPM. Mounted on factory cast iron base. Complete with intercooler, unloader and access.

2—1500 CFM Penna. 110 P.S.I. horiz. 2 stage, Class DCE-2, with direct motor drive 300 HP Elec. Mach. syn. motor, 3 ph. 60 cy. 2300 V. 225 RPM, with intercooler and aftercooler and access. Request Bulletin D-100 for other compr. in stock.

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Box 566 — Dalton, Pa.

ELECTRICAL EQUIPMENT — REBUILT and GUARANTEED
MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

LARGE STOCK OF A.C. and D.C. MOTORS!

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	H.P.	Speed	Volts	Make	Type
1	3	1750	440*	West.	CW-232C
1	5	580	220*	G.E.	HI-9
6	7½	810	550	G.E.	MTC-5201
1	7½	575	220*	G.E.	MT-522
2	10	1149	440*	West.	HF-7A
2	10	570	220*	G.E.	HI-11
3	11‡	810	550	G.E.	ITC-5008
2	15	570	220*	West.	CW-646
1	18	680	440*	West.	MW-316
1	20	860	440*	West.	CW-638
1	25	1130	550	G.E.	MT-323
2	25	850	220*	Wagner	BR
2	25	720	440*	Wagner	22VBR
1	30	865	440*	West.	CW-646
1	30	850	440*	G.E.	MT-332
1	30	675	440*	G.E.	MT-336
2	35	600	440*	F-M	HV-H16A
2	40	865	2200	Al.-Ch.	ARY-223C
1	40	560	440*	G.E.	MT-346
1	50	869	440*	West.	HF-12A
5	52‡	550	220*	G.E.	IQC-5013***
1	60	685	440*	West.	CW-758
1	60	570	550*	G.E.	MTC-5546
1	60	345	550	West.	CW
1	75	720	550	G.E.	MT-556
1	80‡	575	440*	G.E.	MTC-5352
2	125	430	440*	G.E.	IL-16
2	150	1750	440*	G.E.	MTP-549
1	150	900	440*	G.E.	M-6334Z
1	175	505	550	West.	CW-1002
2	200	600	550	G.E.	IM-17
1	200	495	2200	G.E.	IM-17A
2	250	880	2200	G.E.	IM-17A
3	250 (new)	360	440	West.	CW-20-53-15
3	300	900	440*	G.E.	IM-17
1	300	514	550	G.E.	IM-17A
1	400	505	550	West.	CW
1	700 720	2300/4000		West.	CU

* Can be furnished for either 220 or 440 volts but not both voltages.
‡ Intermittent rating.

230 VOLT CONSTANT SPEED D. C. MOTORS

Qn.	H.P.	Speed	Make	Type
22	2	850	West.	SK-20
20	3	1150	West.	SK-20
10	3	850	Reliance	T-23T
25	3½	850	West.	SK-30
3	7½	1750 1310	West.	SK-43
2	7½	1150	G.E.	CDM-66
2	7½	875/1750	West.	SK-631
3	7½	850	G.E.	CD-75
5 (new)	10	1150	Al.-Ch.	EB-80
1	10	850	West.	SK-83
10 (new)	12½	600	West.	SK-93
5	15	825	West.	SK-90
3	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
11	20	750	West.	SK-110L
17	25	825	West.	SK-120
1	30	750	G.E.	RC
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	650	G.E.	RC-16
2	60	1750/1310	West.	SK-143
3	75	850	West.	SK-160
1	150	700	Al.-Ch.	
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

VARIABLE VOLTAGE DRIVES
40 HP, Reliance, Variable Voltage Drives, each Consisting of:
1—40 KW, 250 Volt, Induction M-G Set, with two auxiliary 5 KW generators and exciter.
1—40 HP, 400/1500 RPM, Frame 385T, 230 Volt, DC Motor.
With full magnetic control providing jog forward, jog reverse, run, fast, slow, and stop, and motor operated field rheostat.

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.

Qn.	HP	Speed	Volts	Make	Type
4	1½	1140	440*	West.	CS-225-TEFC
10	5	1730	440*	G.E.	K-254-TEFC
4	7½	1740	440*	G.E.	K-284-TEFC
1	7½	1735	220*	G.E.	KF-284-EX-PF
1	10	1730	440*	G.E.	KF-324-TEFC
1	10	1140	440*	Wagner	CP2-326-TEFC
1	10 (new)	880	220*	West.	CS-365-EX-PF
1	15	3485	220*	Reliance	AA-B3247
1	20 (new)	3475	220*	West.	CS-326
2	20	1169	440*	West.	CS-554
4	25	1170	220*	L.A.	JX-405-TEFC
1	25	1140	2200	West.	CCL
1	25	705	440*	West.	CS-W504-TEFC
1	30	1160	440*	West.	CS-644
1	30	870	220*	West.	CS-646
1	40 (new)	3545	220*	G.E.	KF-404S
1	40	1200	440*	G.E.	KT-332
3	40	1175	220*	G.E.	K-445
2	40	900	2200	G.E.	FTR-536
1	40	1765	220*	West.	CS-444-TEFC
5	50	1160	220*	G.E.	K-504
1	50	850	220*	West.	CCL
2	60	900	440*	G.E.	KT-346
1	75	1750	2200	West.	CS-761
1	100	1765	2200	West.	CS-765A
1	100	870	440*	G.E.	KT-356
1	100	690	220*	West.	C
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.-Ch.	AN
2	125	390	2200	G.E.	I-17-R
1	150	1780	440*	G.E.	K-547
3	150	1175	2300*	G.E.	KTP-557
2	200	1750	440*	West.	CS-8558
4	200	580	550‡	G.E.	KT-566S
4	350	1750	2300	G.E.	K-559
1	500	1200	440*	G.E.	KTP-567
1	700	1800	2300/4000	West.	CS-4-39D-12

* Can be furnished either 220 or 440 volts but not both voltages. ‡ Reconnectable for 440 volts.

230 VOLT ADJ. SPEED D. C. MOTORS

Qn.	H.P.	Speed	Make	Type
10	1½/2	500/200	G.E.	CD-65
1	2	225/900	Reliance	78T
2	6	450/1800	G.E.	RF-9
6	5/7½	600/1800	G.E.	RA-30
1	12½	280/840	West.	SK-130
10 (new)	12½	600	West.	SK 93
1	15/20	500/1500	G.E.	CD-95
1	20	400/1600	G.E.	RF-12
1	20/25	300/1200	West.	SK-153
1	23/29	300/1200	G.E.	RF-13
1	30	400/1200	West.	SK-163
1	35	500/1500	West.	SK-143
2	40/50	400/1600	Al.-Ch.	EB-147
1	75	500/1500	Cr.-Wh.	CCM
1	75	375/750	Cr.-Ch.	CMC-135H
3	100	225/900	G.E.	MPC-A
5	100	400/1200	Al.-Ch.	
1	100	320/960	West.	SK-200
1	175	230/750	West.	SK-220
2	375	350/500	G.E.	MPC

CRANE, MILL TYPE 230 V. D. C. MOTORS

Qn.	H.P.	Speed	Make	Type
2 (115 v.)	3½	700	G.E.	CO-1803
2	5½	760	West.	MCB-20
1 (new)	10	650	G.E.	MD-403-BE
1	20	515	West.	K-6
3	25	590	Diehl	TE
2	27	490	West.	MC-40
2	35	750	G.E.	CO-1828
3 (new)	35	600	West.	CK-9
1	50	750	G.E.	CO-1829A
1	50	600	West.	CK-9
5 (new)	50	525	G.E.	COM-1830AE

NEW SQUIRREL CAGE—B. B.
1800 RPM, 3 Ph., 60 Cy., 220/440 V.

Qn.	H.P.	Make	Type
15	1	G.E.	K-203
15	2	G.E.	K-224
15	3	G.E.	K-225
15	5	G.E.	K-254
10	7½	Al.-Ch.	AP-284
6	10	G.E.	K-324

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment Is Located In Our Cleveland Warehouse. We have Controls for Most Items Listed

ELECTRIC GENERATOR & MOTOR CO.
4521 HAMILTON AVE. — CLEVELAND 14, OHIO

COMPLETE POWER PLANTS

STEAM—ELECTRIC—HYDRO—DIESEL

"Export Orders Carefully Executed"

As evidence of our ability to serve you well please note we have shipped on orders in the past 8 months 73 carloads of Power Plant Machinery, 29 of Cars going for Export Orders.

1—4000 KW Westinghouse Turbo-Generator Condensing. Excellent Condition
1400 2200 KW Turbo-Generator, non-condensing. Excellent Condition

2—35,000# Modern Boilers 200#
2—60,000# Boilers 250
4—1000 H.P. Heine Boilers 225#
2— 325 H.P. B & W Sterling Boilers 200#
2— 600 H.P. Edge Moor 200# Stokers
Smaller Boilers and Tire Tube Boilers also
2—3000 K.W. Turbos @ 350#

2—2500 K.W. G.E. Co., Turbo-Generator Condensing
2—2000 K.W. G.E. Co., Turbo-Generator Condensing
1—6500 K.W. G.E. Co., Turbo-Generator Condensing
1—2000 K.W. W.E., & M. Co., Turbo-Generator Con.
2—1000 K.W. G.E. Co., Turbo-Generator Condensing
2— 750 K.W. G.E. Co., Turbo-Generator Condensing
Several 500 KWs & Smaller Units

Non-Conducting Turbos—300—500—750—and 1,000 K. W. & Larger

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KIEMLE OFFERS

Rebuilt and Sold with a Standard New Guarantee

IND. FREQUENCY CHANGER SETS

MOTOR GENERATOR SETS
ALTERNATORS, ALL FREQUENCIES
TRANSFORMERS, LARGE STOCK
D. C. GENERATORS, ALL VOLTAGES
CONTROL EQUIPMENT

ALL SIZES
VOLTAGE AND CYCLES

3 ph. 60 cy. A.C. Motors
3 ph. 25 cy. Motors
125 Volts D. C. Motors
230 Volts D. C. Motors
550 Volts D. C. Motors

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Put all idle equipment to work. Send your list for prompt action. **WRITE OR WIRE YOUR INQUIRIES**

TURBO GENERATORS and BOILERS

1000 KW., 3 phase, 60 cycle, 480 volt, 3600 RPM., General Electric, rigid frame type non-condensing, 160 lbs. and 25 lbs. back pressure.

750 KW., 3 phase, 60 cycle, 2300 volt, 3600 RPM., Gen. Elec. rigid frame type, non-condensing 125 lbs. and 5-10 lbs. back pressure.

750 KW., General Electric rigid frame type 3600 RPM., 150 lbs. extraction 10 lbs. Generator can be wound for 220, 440, 550 or 2300 volts.

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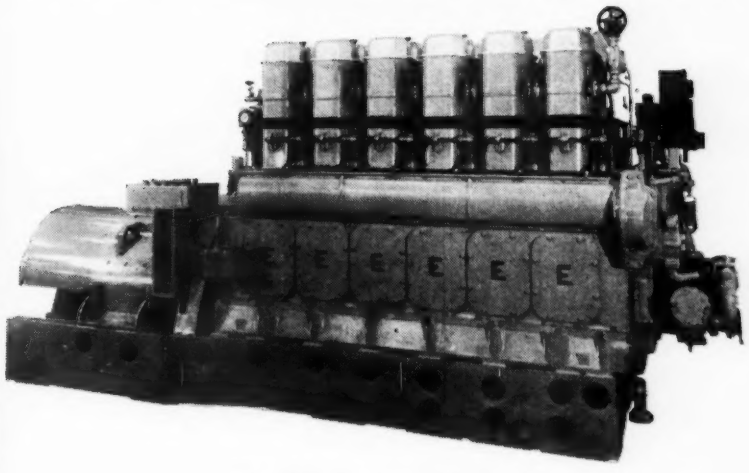

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15—250 KW. Elliott Direct Current Generators, 120/240 volt, 3 wire compound wound, 450 RPM. Complete with all necessary auxiliaries.

Large supply of brand new spare parts available

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8—1600	General Motors 16-278A	1200	720	95%
1— 450	Fairbanks Morse 32F	375	360	95%
1— 375	McIntosh Seymour	350	360	85%
1— 365	Ingersoll Rand S	340	600	95%
4— 360	Fairbanks Morse YVA	300	257	80%
5— 350	General Motors 8-268A	250	1200	95%
1— 300	Buckeye Model E	250	400	90%
2— 240	Fairbanks Morse YVA	200	257	85%

HP	MODEL	KVA	RPM	NEW
10—225	Buckeye Model 80	180	600	new
1— 180	Fairbanks Morse YVA	150	257	95%
3— 165	Murphy ME650	145	1200	95%
3— 150	Worthington 8B	125	600	99%
2— 150	Buckeye Model E	145	400	95%
1— 90	Cummins HIS 600	62.5	1200	new
1— 80	Fairbanks Morse YVA	65	300	85%
1— 75	Buckeye Model J	62.5	600	95%
1— 40	Buckeye Model J	30	600	95%

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375 KVA Fairbanks Morse, 480 v.—Model 32E-14
250 KVA Fairbanks Morse 2300/440 v.—Style VA
225 KVA Westinghouse 2300/440/220 v.—Worthington
187 KVA Fairbanks Morse 2400/440/220 v.—Marine Type
156 KVA Ideal 240/480 v.—Buckeye
93.8 KVA Electric Machinery—Superior
75 KVA General Motors 440/220 v.

TURBO UNITS (NON-COND.)

37½ KVA Westinghouse 240/480 v.
125 KVA General Electric 240 v.
155 KVA (2) Allis Chalmers 220/440 v.—Terry
250 KVA General Electric 220/440 v.
250 KVA GE 600 v.—GE 30# BP
280 KVA General Electric 2300 v.—Terry
2500 KVA General Electric 480/240 v.

TURBO UNITS (COND.)

750 KVA GE; 2300 v. 250#
750 KVA General Electric 240/480 v.
940 KVA Westinghouse 6600 v.
1250 KVA General Electric, 2300 v.
1250 KVA Westinghouse 2300 v.
1250 KVA General Electric 600 v.
1250 KVA (2) Allis Chalmers 4000/2300 v.
1875 KVA (2) General Electric 2300 v.
2500 KVA General Electric 600 v.

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254 HP (2) Sterling 200#
403 HP Sterling 250#
406 HP (2) Heine 180#
467 HP (3) Edgemoor 200#
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507 HP Heine, bent tube, 400#
514 HP Erie City cross drum 200#
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1038 HP Springfield 200#

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79 KVA Allis Chalmers 480/240 v.—Ames Unif.
187 KVA General Electric 240/480 v.—Chuse 4 v.
187 KVA Westinghouse 240/480 v.—Ames Unif. Ver.
375 KVA General Electric 2300/440 v.—Chuse 4 v.
450 KVA General Electric 2300/440 v.—Ames Unif.
500 KVA Crocker Wheeler 240/480 v. — Nordberg Unif.
750 KVA General Electric 2300/480 v.—Chuse Unif.
688 KVA Allis Chalmers 600 v.—Al Chal. Corliss

SYNCHRONOUS CONDENSER

750 KVA Wghse.; exciter; starting equipment

GAS ENGINE UNIT

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750 KW Crocker Wheeler-DeLaval

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3/60/2200 Volts

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Size 7 x 14 x 10, #15625
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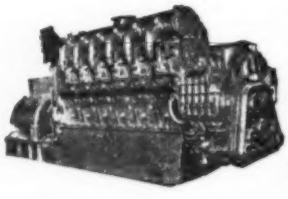

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300 KW, 450/2400 volts, 3 phase, 60 cycle, 1200 RPM, General Motors Model 8-268A
250 KW, 450 volts, 3 phase, 60 cycle, 1200 RPM, General Motors Model 8-268A
200 KW, 450/2400 volts, 3 phase, 60 cycle, 1200 RPM, General Motors Model 8-268A
125 KW, 220/440/2400 volts, 3 phase, 60 cycle, 1200 RPM, General Motors Model 3-268A
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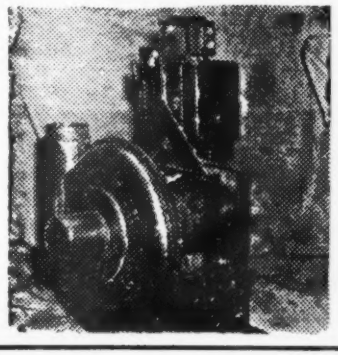

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One Skinner Uniflow Engine Generator Unit consisting of and including the following equipment:
Skinner Uniflow Engine No. 9484—125-150# steam pressure—Side Crank size 21" x 22" speed 200 r.p.m. Generator on right hand side no Tailrod and no Steam Separator, has 6" pipe and throttle valve, drain piping and steam trap.
General Electric A.C. Generator No. 1012025 type ATB—36—312 KVA 200—Form E. Amps. 78.5—2300 volts—60 cycle P.F. .8 250 K.W.
A.C. Generator Field Rheostat—no data—plate removed, operating chain removed.
Exciter—General Electric D.C. No. 668737 type ML—Frame G. form 1—amps. 96-12 K.W. volts 125—with field rheostat and belt.

One Skinner Uniflow Engine Generator Unit consisting of and including the following equipment:
Skinner Uniflow Engine No. 8975—125-150# steam pressure—Center Crank size 21" x 22" speed 200 R.P.M. Generator on right hand side, has tailrod through cylinder head, no outside support.
No steam separator, has 6" pipe bend and throttle valve drain piping and steam trap.
Allis-Chalmers A.C. Generator No. 104847—325 KVA 2300 volt, 3 phase 60 cycle—81.9 amps. 200 R.P.M. Generator Field Rheostat—Cutler Hammer Mfg. Co. No. 11141H101—Max. volts 125—Max. amps. 160—Ohms. 2.5.
Exciter—Allis Chalmers—No. 3K4273.3—volts 120 with belt. amps. 125—speed 1100 R.P.M. field dis. ris. No. 771438.
Exciter — Field Rheostat — (G.E.) CR-8001 — Cat. #43599. Amps. 6.8—volts 125.

STEAM GENERATING EQUIPMENT

Turbo Generator and related equipment.
Allis-Chalmers No. 102 150#, 3600 R.P.M. 500 Kw Steam Turbine, direct connected to Allis-Chalmers 125 amp. 2300 volt, 3 phase, 60 cycle generator.
C. H. Wheeler 1650 square feet closed type condenser equipped with copper-nickel tubes and Croll-Reynolds air jet.
Worthington type LA-1, 2500 G.P.M., 44 ft. total head, centrifugal type circulating pump complete with 40 H.P. 1750 R.P.M., 2300 volt, 60 cycle, 3 phase motor.
Worthington type 2-UB-1, 75 G.P.M., 90 ft. total head, condensate pump complete with 5 H.P. 230 volt, 3 phase, 60 cycle, 1150 R.P.M. motor.
Complete reducing and de-superheating equipment and controls to reduce and de-superheat steam from 250# 125° superheat to operating pressure and temperature for above 500 Kw turbine.
All necessary gauges, etc., for 500 Kw turbine.
The above equipment is in first class condition. The turbo-generator and related equipment is capable of generating 1000 Kw at 1.00 P.F. The equipment will be in service until January 15, 1948 and can be inspected operating under maximum load conditions.

MONTANA-DAKOTA UTILITIES CO.
831-2ND AVE. S.
MINNEAPOLIS 2, MINNESOTA

FOR SALE

DETROIT ROTO STOKER

1 New, unused stoker. Designed for 600 HP B & W boiler. Guaranteed 200% rating. Three 27" rotors, 13 x 9', stationary grates, complete for installation. Purchasing power reason for selling.

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Goodman, Wisconsin

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2—500 KVA Pittsburgh
1—500 KVA Westinghouse
3—250 KVA Westinghouse
3—150 KVA Pittsburgh
6—150 KVA General Electric

All single phase, 60 cycle, 23000/2300 volts, in operating condition and available for immediate delivery.

W. G. DUNCAN COAL COMPANY
Greenville, Kentucky

FOR SALE

POWER PLANT EQUIPMENT

Ridgway Engine Generator Set, number 3383, 90 H.P., Bore 11 inches, Stroke 12 inches.

Ridgway Alternator, number 338, 90 KVA, 190 Amps, 230 V, 60 cycles, 277 RPM, Design number 36S03.

Ames Engine, 10 x 11, number 33940, A C Generator, number 414617, Type AQB 24-50-300, Form E, KW 50, PF 1, Amp 104, Speed 300, Full Load 240, 220 V.

MAJESTIC LAUNDRY CO.
Ashmun Street at Lock
New Haven, Conn.

GENERATOR

FOR SALE

600 K.W. Allis-Chalmers .8 PF 440/3/60 Generator direct connected to 120 RPM Allis-Chalmers Cross Compound Steam Engine designed for 115 P. S. I. G. (H.P. cylinder can be sleeved at nominal cost with factory recommendation to operate at 175#), 450°F. max. temp., including generator panel also 440/360 M.G. Exciter.

Location: Near Honolulu, Hawaii.

Offered by original purchaser. Condition excellent—has seen little use; very reasonably priced for quick sale.

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Box 3440, Honolulu 1, Hawaii

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FOR SALE

Twelve practically new Westinghouse 1.5/2 HP, Frame FD-284, Ball Bearing, 230 volt, shunt wound, Tapered HP 12.5/50 RPM, Constant Torque 1.25/12.5 RPM.

Write—Wire—Phone

DELL STEPHENSON & CO.
2534 Guardian Bldg. Detroit 26, Mich
Cherry 7392

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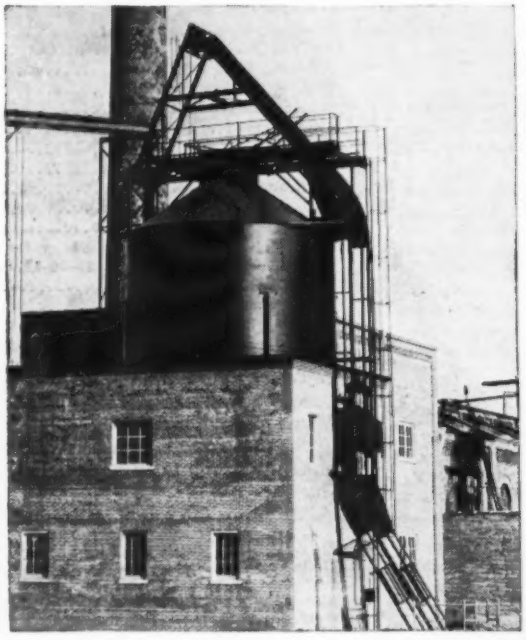
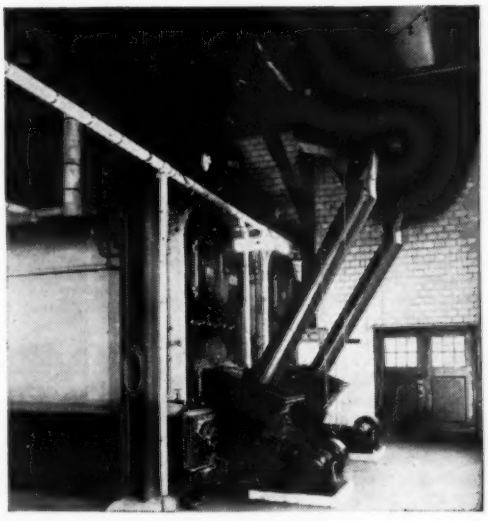
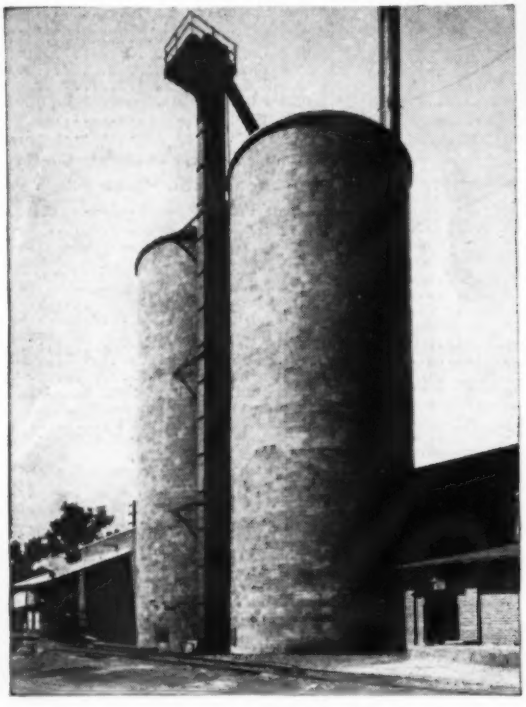
CYLINDRICAL OR SUSPENSION BUNKERS–SILOS







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• To meet the various requirements of power plants Fairfield designs—builds and erects equipment to meet specific needs.

Top left shows a cylindrical steel bunker of 200 ton capacity. Coal is received in railroad cars and delivered to bunker by a skip hoist having 30 tons per hour capacity. A motor propelled weigh larry discharges coal to the stokers.

Top right shows a steel suspension bunker employing chutes for discharging coal to stokers.

At the left is shown a typical twin silo installation for 800 ton coal storage outside of boiler house. Coal is fed automatically from car to storage to pulverizer or stoker.

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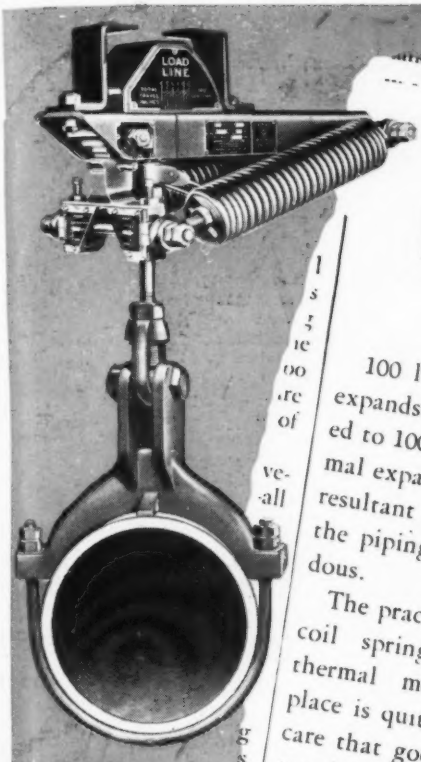
Builders of Coal and Ash Handling Equipment

The FAIRFIELD Engineering Co.

320 CHICAGO AVE. • MARION, OHIO



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Provide constant support to piping subject to vertical movement. Full safety factor of supported system is always maintained.

High Temperature PIPE SUSPENSION ... a new science

100 linear feet of steel pipe expands 9.4 inches when heated to 1000° F. When this thermal expansion takes place, the resultant forces induced into the piping system are tremendous.

The practice of using helical coil springs to allow this thermal movement to take place is quite general, but the care that goes into the design or selection of flexible supports is looked upon by many as a casual matter. In fact, many specifications covering the support of important high temperature piping will simply say "spring hangers shall be provided." Merely to contend that this is a dangerous practice is not enough.

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From a paper presented before the American Petroleum Institute and published in the magazines PETROLEUM PROCESSING and PETROLEUM REFINER.

Literature on the importance of flexible pipe supports and the method of determining supporting forces and also material that is helpful in calculating hanger loads has been recently prepared by Grinnell Company and is available on request.

GRINNELL PRE-ENGINEERED SPRING HANGERS

Permit thermal movement of piping. Patented precompression feature assures operation of spring within its proper working range where variation in supporting force is at a minimum.

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- Pipe, Valves and Fittings
- Engineered Pipe Hangers
- Grinnell-Saunders Diaphragm Valves
- Thermolier Unit Heaters
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- Oil, Water Works and Industrial Piping Supplies

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Automatic Sprinklers and Special Hazard Fire Protection Systems

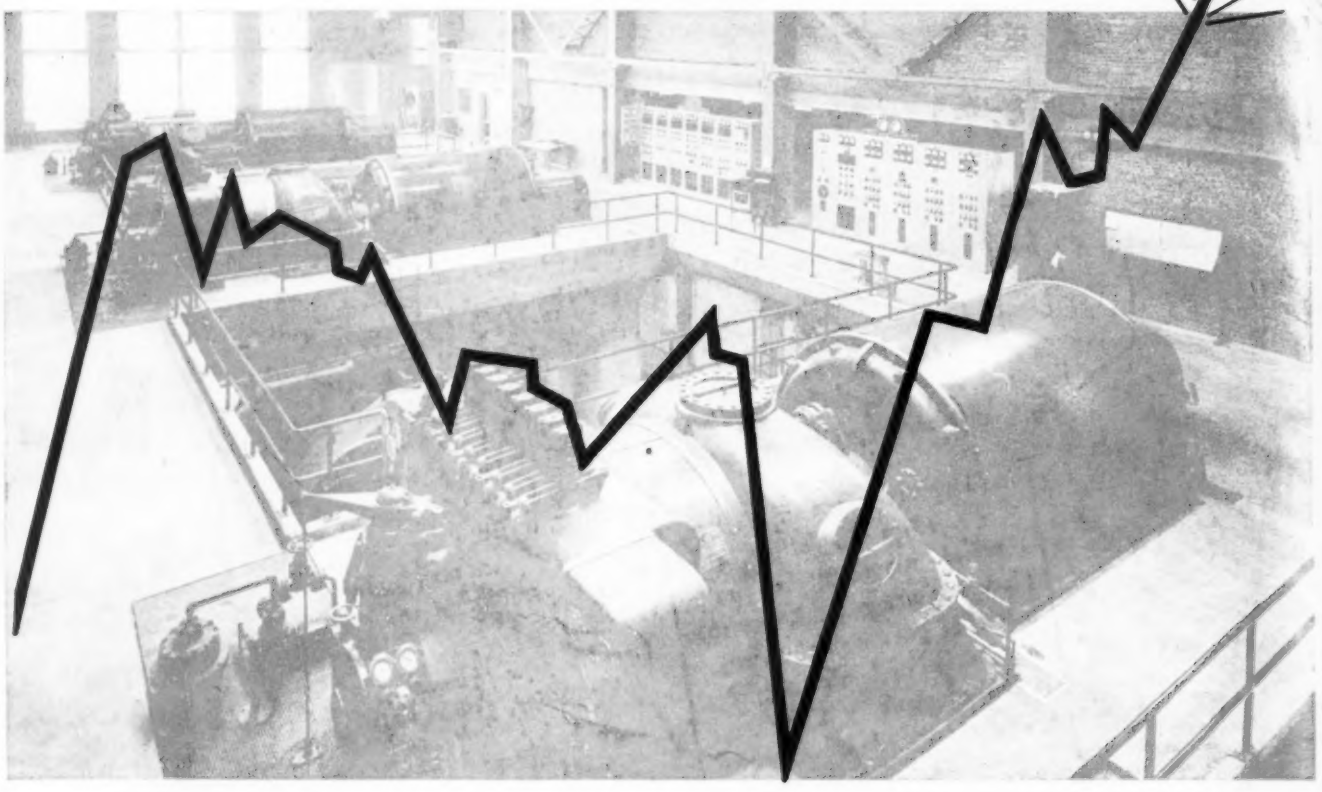
AMCO Humidification and Cooling Systems

GRINNELL COMPANY, INC.
Executive Offices
PROVIDENCE 1, RHODE ISLAND

GRINNELL

WHENEVER PIPING IS INVOLV

ASSURE POWER OUTPUT



...TO MEET RECORD DEMANDS

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TEXACO

TEXACO Regal Oils (R&O)

FOR ALL TURBINES

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